US009139806B2

(12) **United States Patent**
**Oouchi**

(10) **Patent No.: US 9,139,806 B2**
(45) **Date of Patent: Sep. 22, 2015**

(54) **MICROBIAL COUNTING CELL, MICROBE COUNTING DEVICE USING SAME, AND MICROBE COUNTING METHOD USING SAME**

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(73) Assignee: **Panasonic Healthcare Holdings Co., Ltd.**, Tokyo (JP)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/575,037**

(22) PCT Filed: **Aug. 29, 2011**

(86) PCT No.: **PCT/JP2011/004776**

§ 371 (c)(1), (2), (4) Date: **Jul. 25, 2012**

(87) PCT Pub. No.: **WO2012/029273**

PCT Pub. Date: **Mar. 8, 2012**

(65) **Prior Publication Data**

US 2012/0288890 A1 Nov. 15, 2012

(30) **Foreign Application Priority Data**

Aug. 30, 2010 (JP) ................................ 2010-191809
Oct. 18, 2010 (JP) ................................ 2010-233222
Oct. 18, 2010 (JP) ................................ 2010-233223

(51) **Int. Cl.**
***C12M 1/34*** (2006.01)
***C12M 1/26*** (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC .............. ***C12M 41/36*** (2013.01); ***B01L 3/5029*** (2013.01); ***G01N 15/0656*** (2013.01); *B01L 2300/0609* (2013.01); *B01L 2300/0851* (2013.01); *G01N 2001/028* (2013.01)

(58) **Field of Classification Search**
CPC ................. C12M 41/36; B01L 3/5029; B01L 2300/0609; B01L 2300/0851; G01N 15/0656; G01N 2001/028
USPC ..................................... 435/39, 287.1, 309.1
See application file for complete search history.

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*Primary Examiner* — William H Beisner
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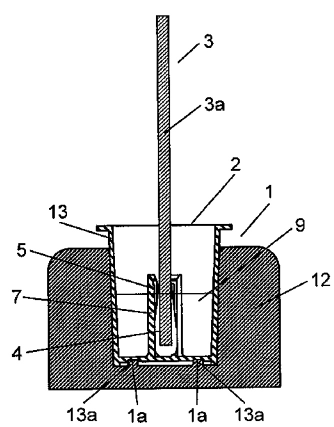
(74) *Attorney, Agent, or Firm* — RatnerPrestia

(57) **ABSTRACT**

A microorganism counting cell of the present invention includes bottomed cylindrical vessel that includes upper surface opening and cylindrical retaining body disposed vertically on a bottom surface in vessel, a collecting element provided on a lower end portion of a rod-shaped cotton swab being inserted in retaining body from upper surface opening. In the microorganism counting cell, elution protrusion is provided on an interior side surface of retaining body, and elution groove that pierces retaining body from an inside to an outside is provided on a side surface of retaining body.

**20 Claims, 36 Drawing Sheets**



(51) **Int. Cl.**

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|---|---|
| ***G01N 27/26*** | (2006.01) |
| ***B01L 3/00*** | (2006.01) |
| ***G01N 15/06*** | (2006.01) |
| *G01N 1/02* | (2006.01) |

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FIG. 1

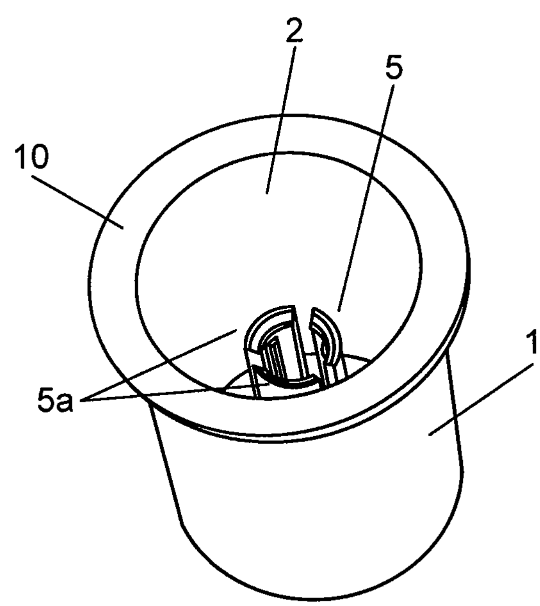


FIG. 2A FIG. 2B FIG. 2C

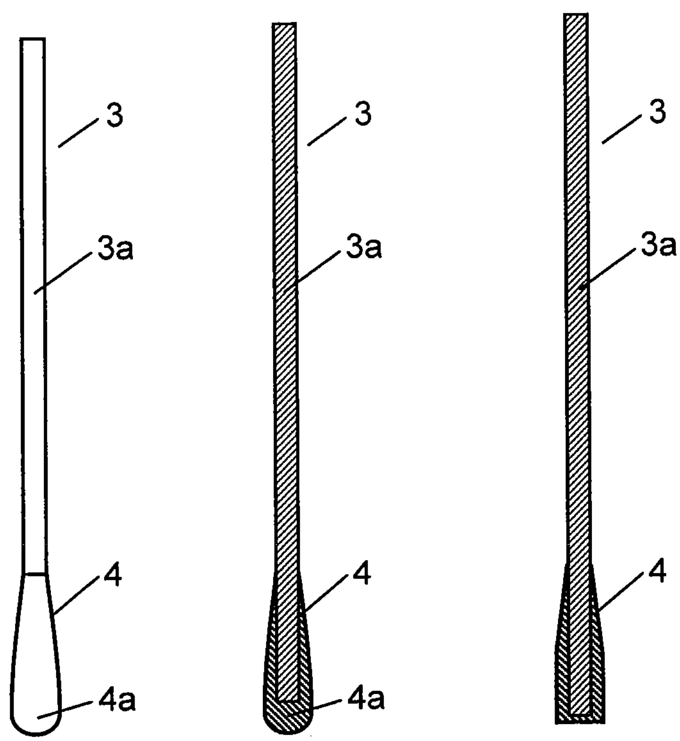
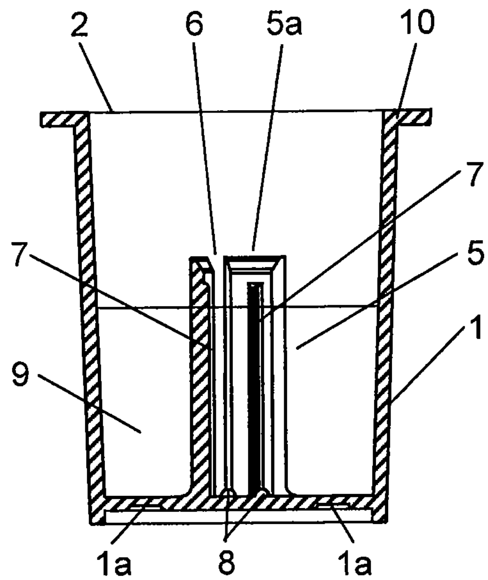


FIG. 3A

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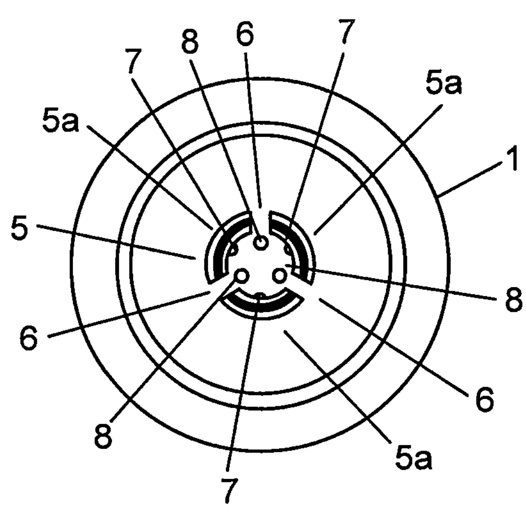

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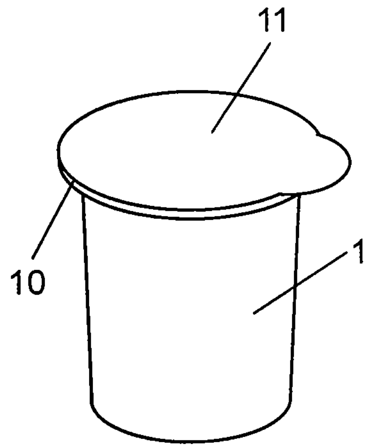



FIG. 5

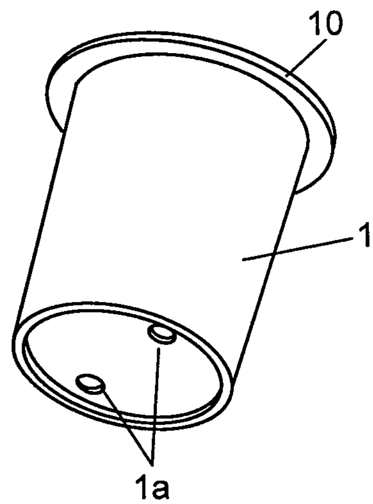


FIG. 6

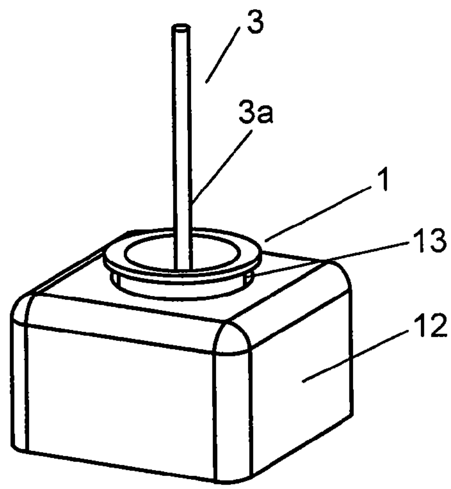
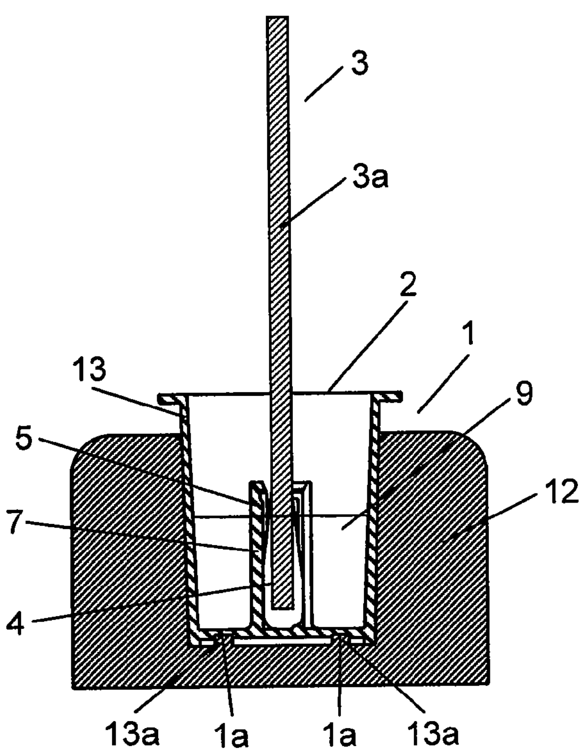



FIG. 7



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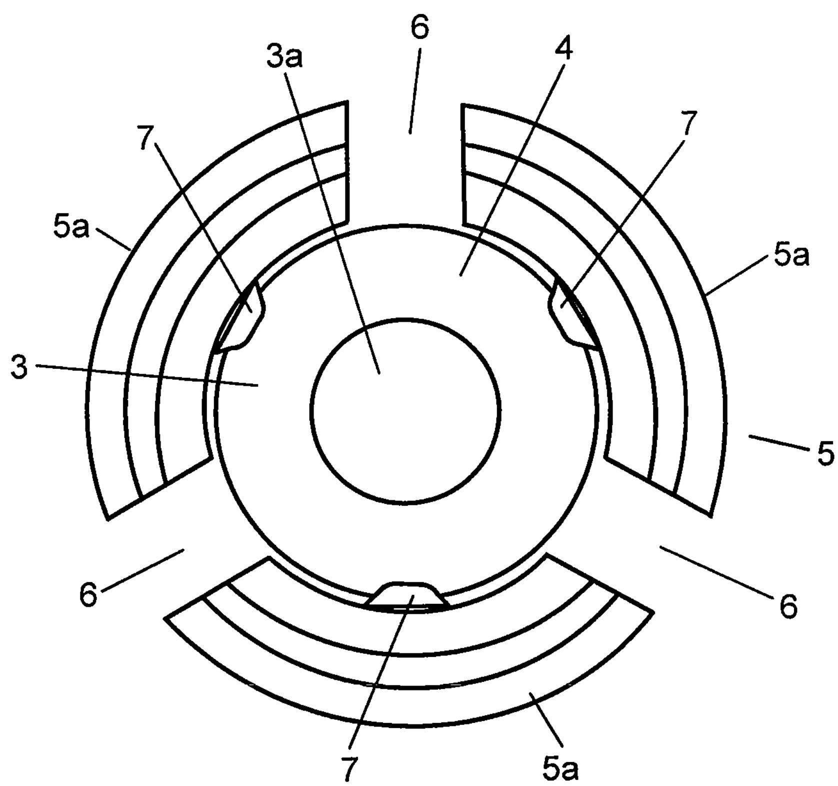
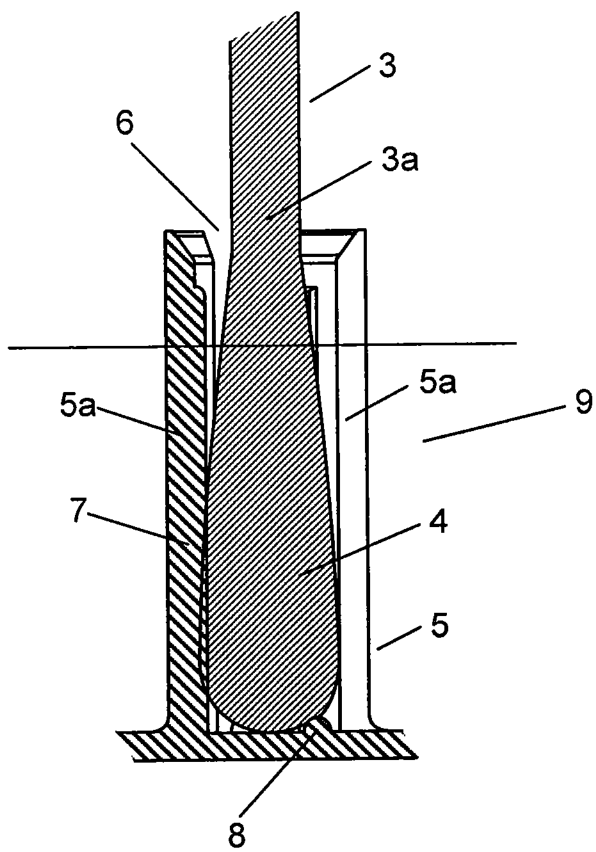


FIG. 9



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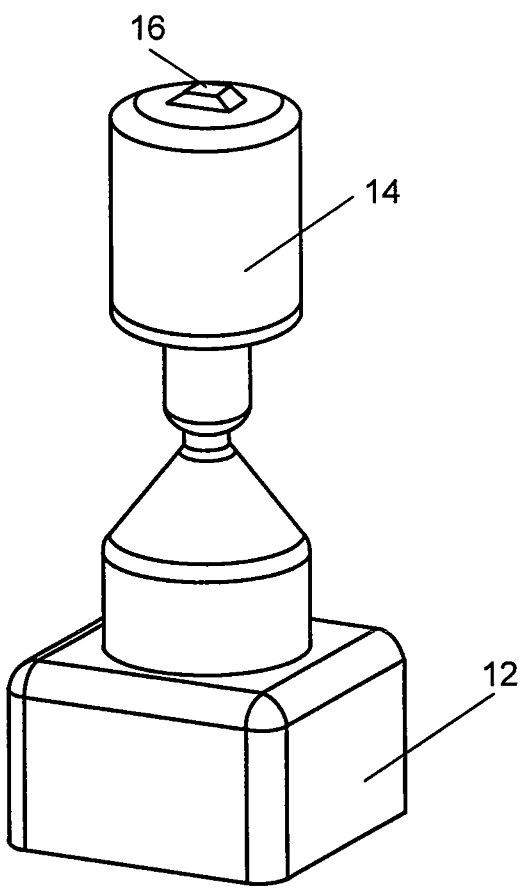


FIG. 11

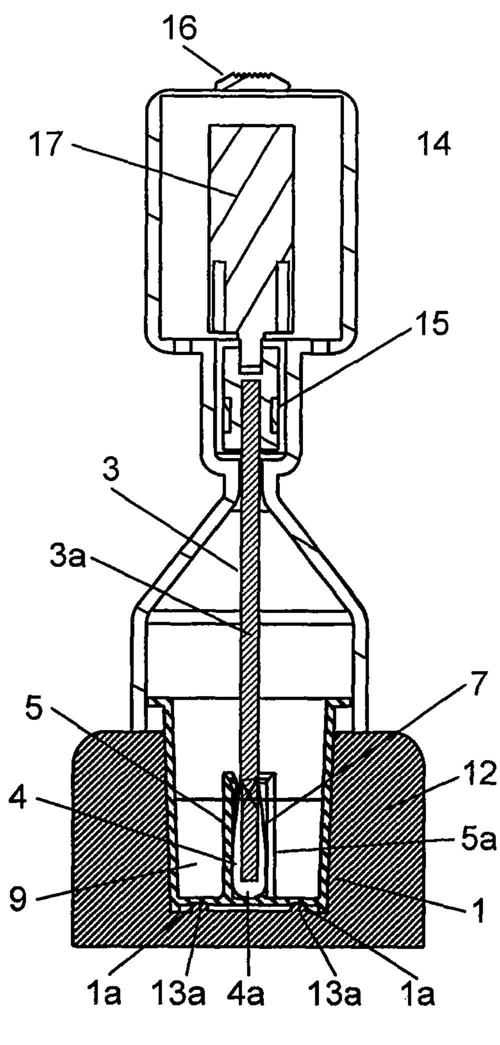


FIG. 12A

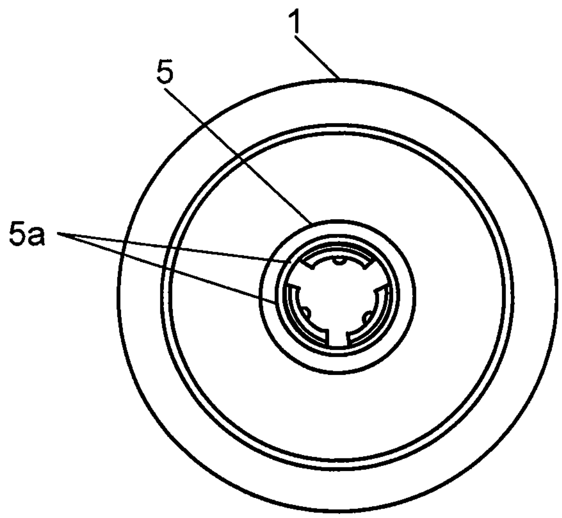



FIG. 12B

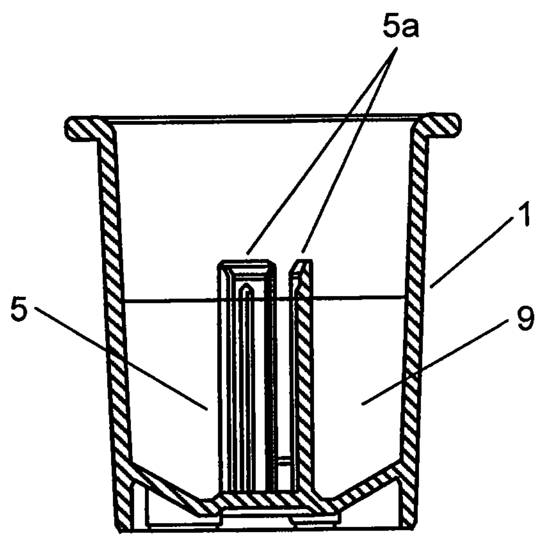


FIG. 13

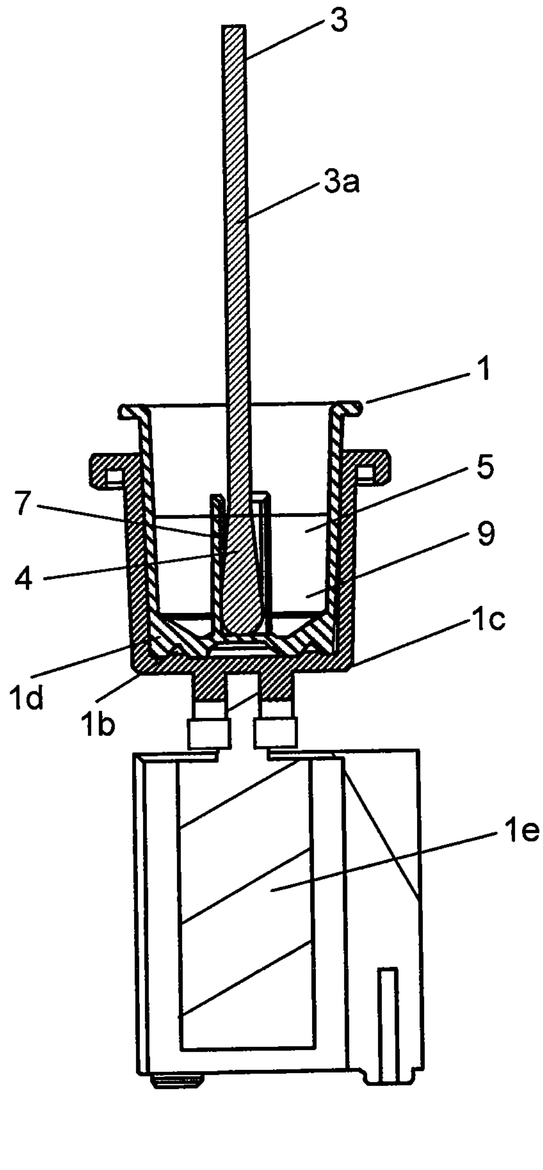
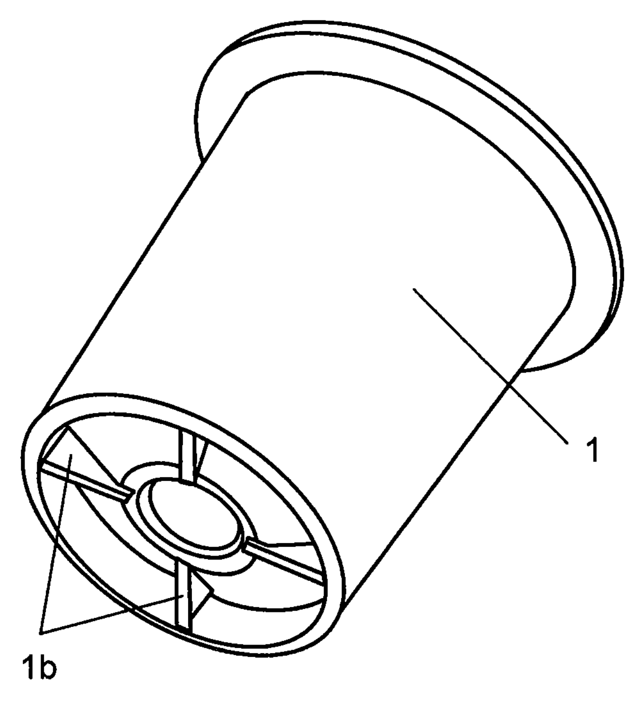


FIG. 14



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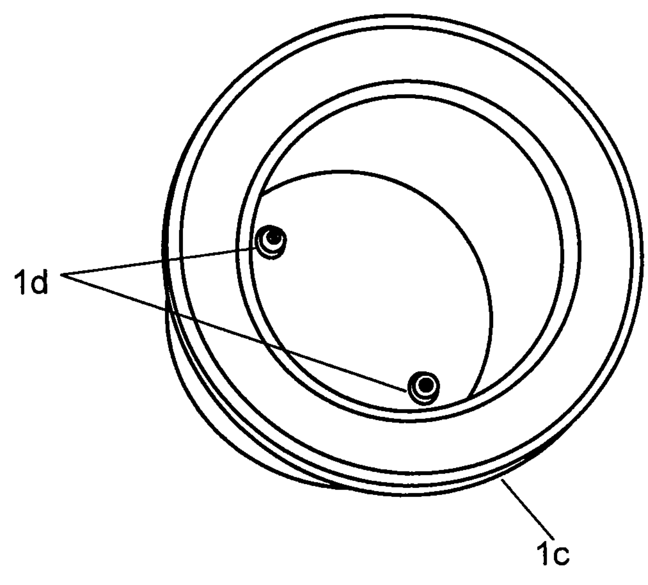


FIG. 16

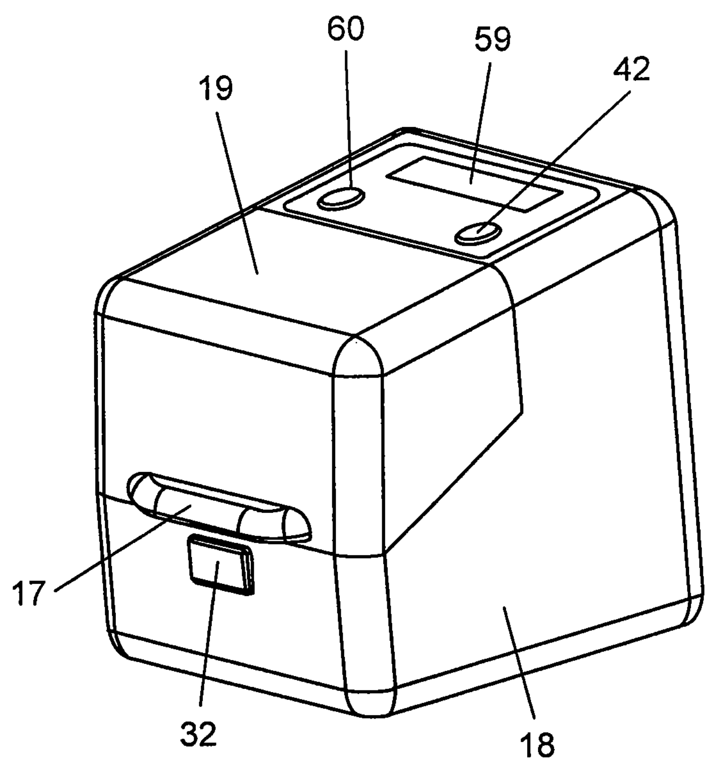


FIG. 17

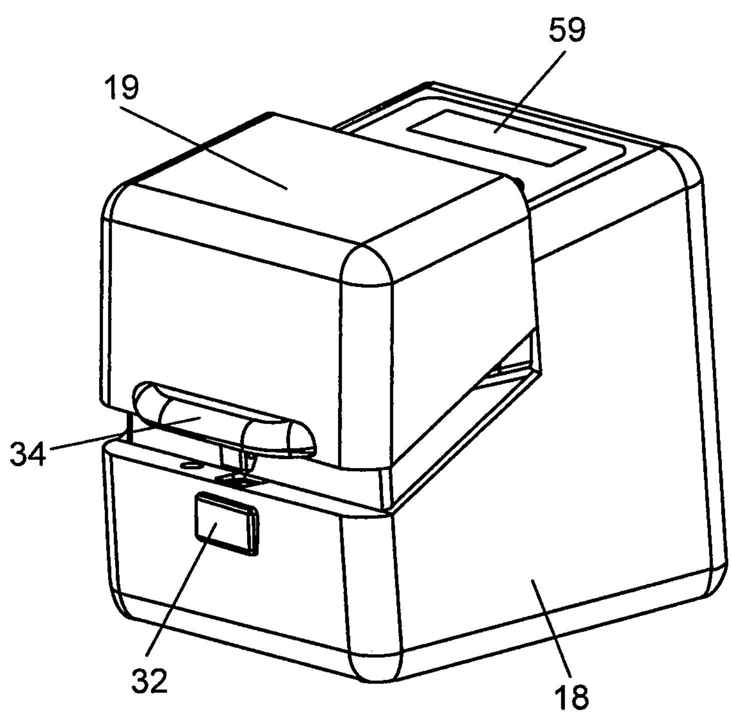
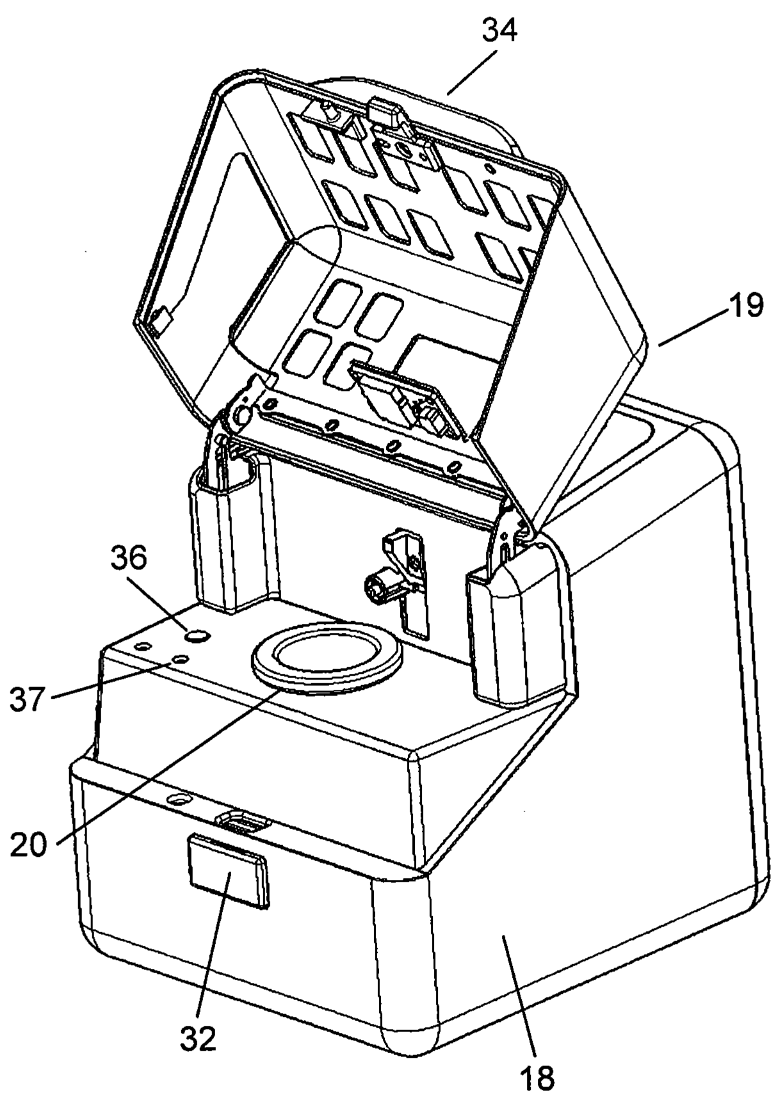


FIG. 18



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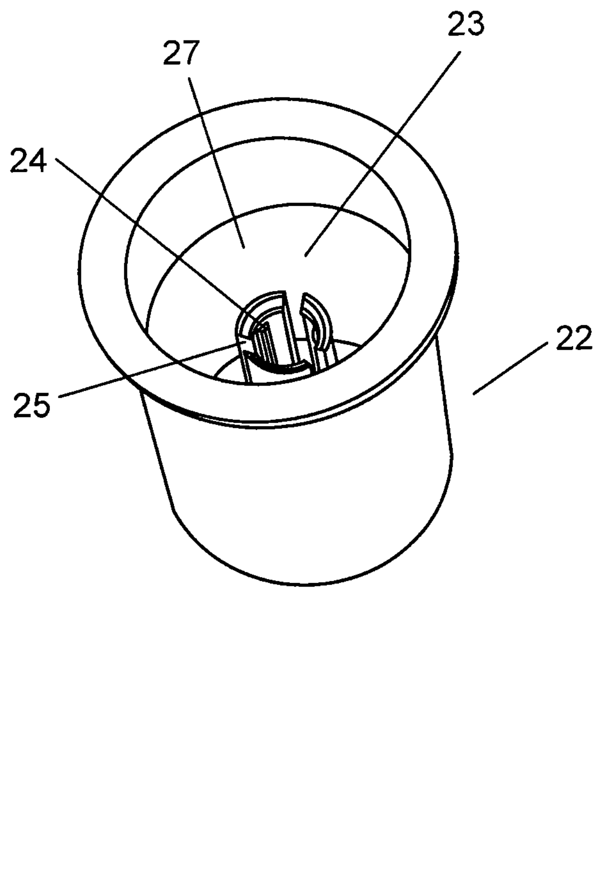


FIG. 20A

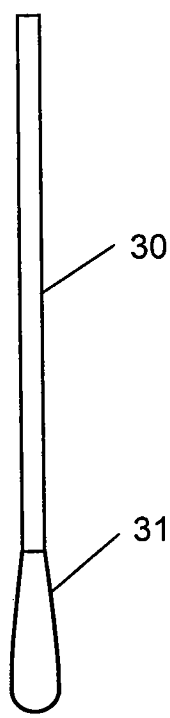



FIG. 20B

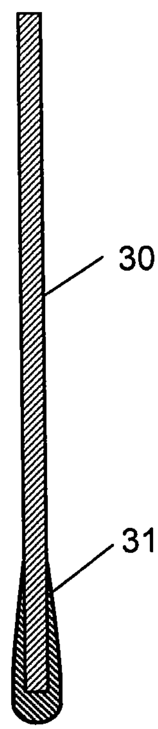
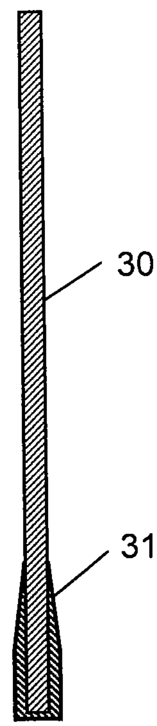



FIG. 20C



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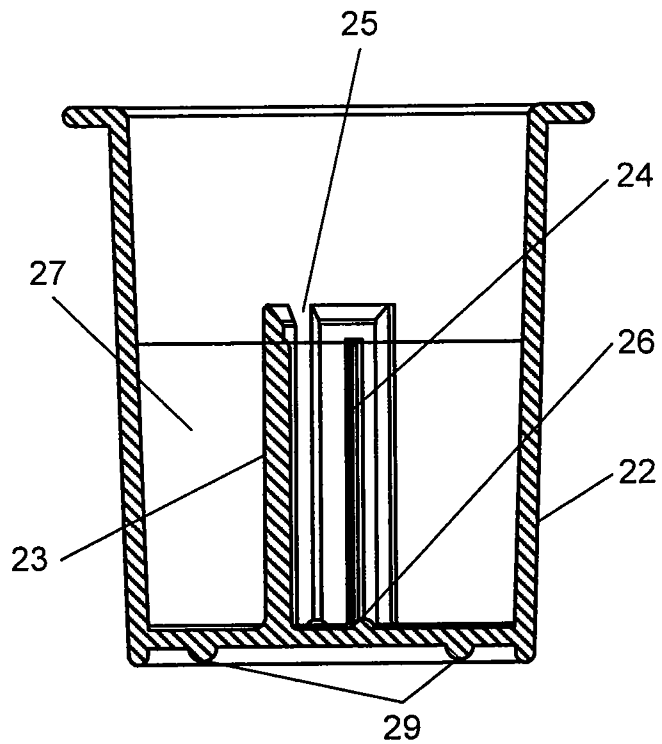


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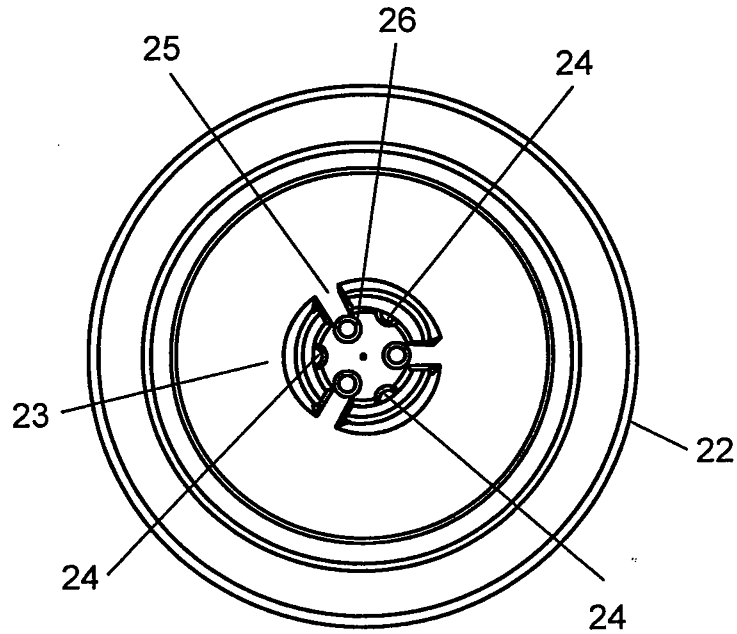

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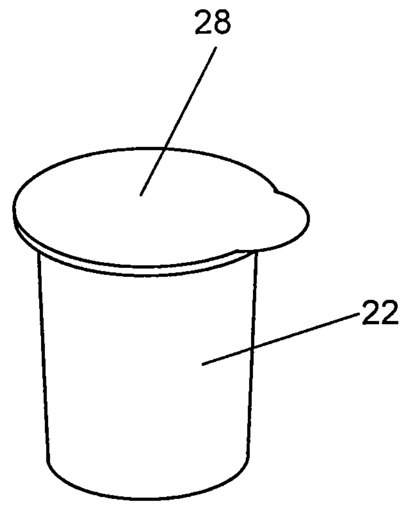


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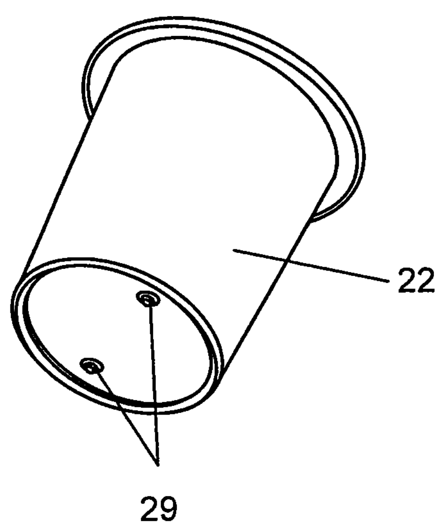


FIG. 24

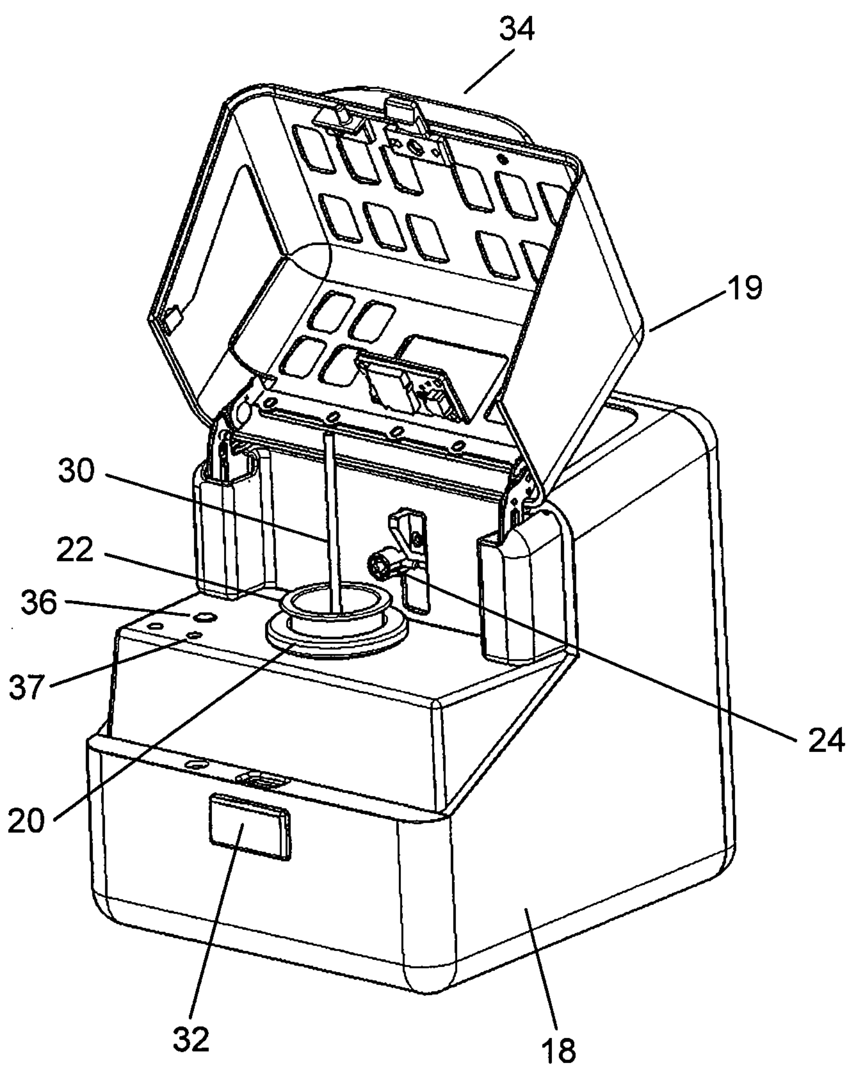


FIG. 25

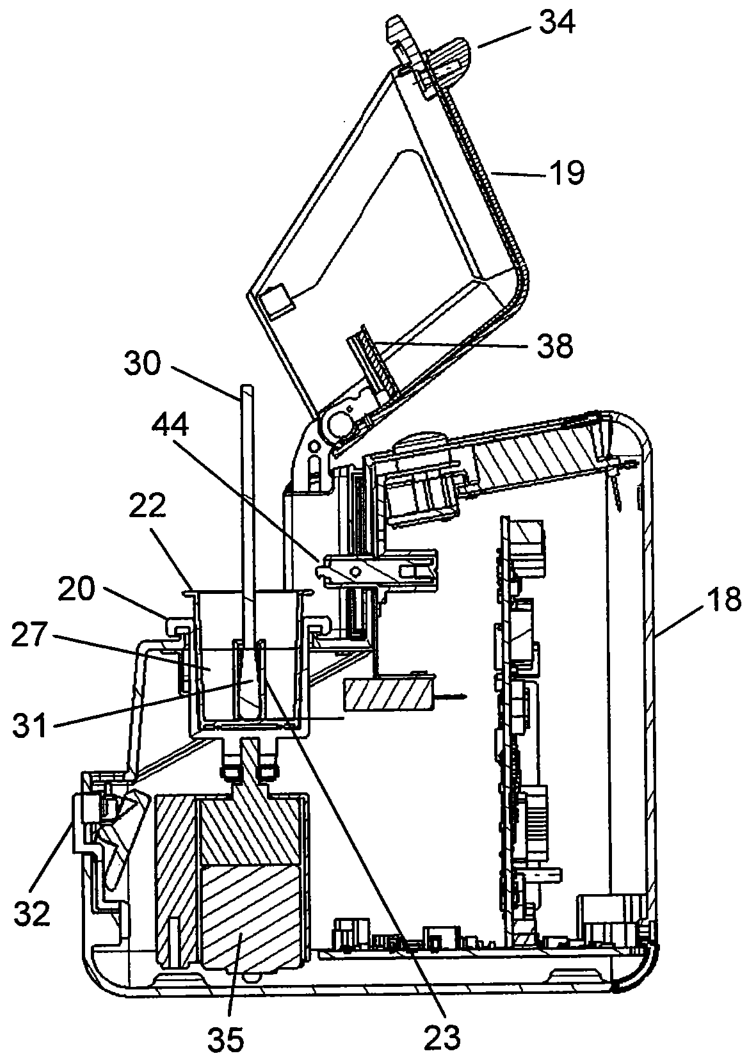


FIG. 26

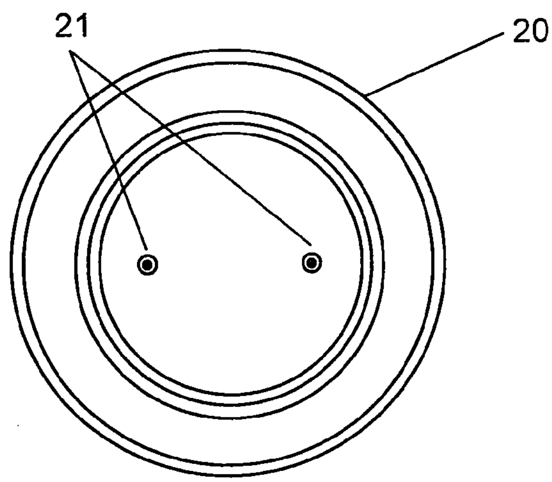



FIG. 27

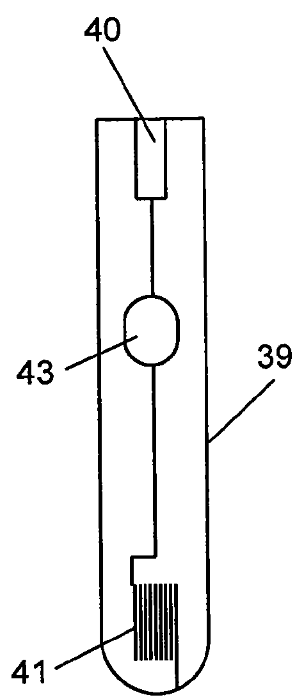
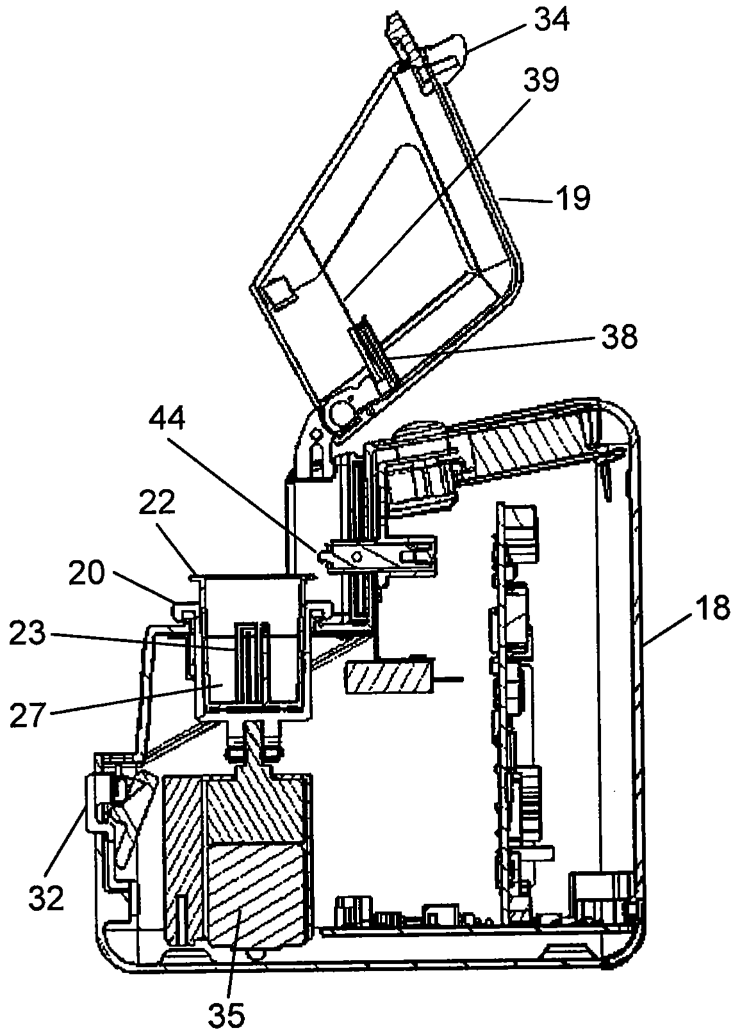


FIG. 28



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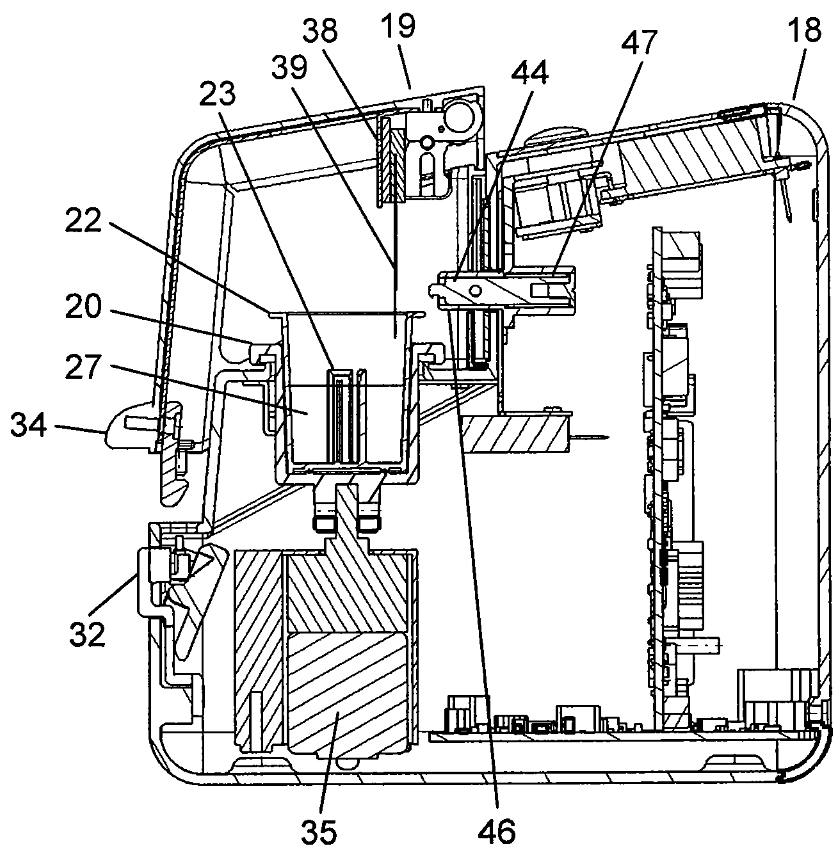

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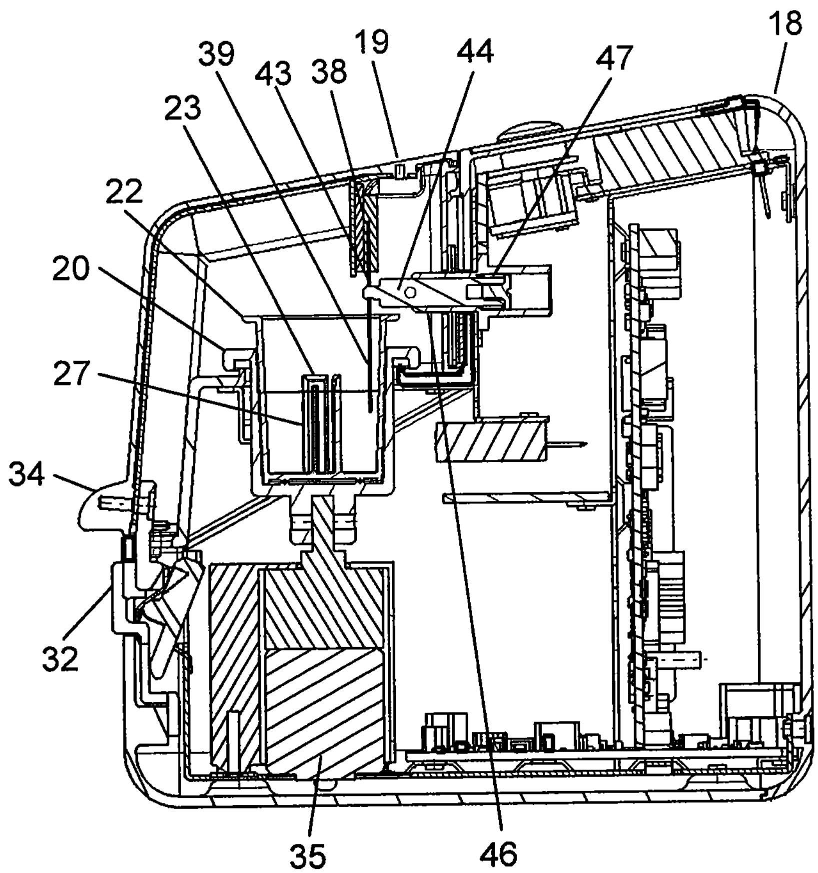

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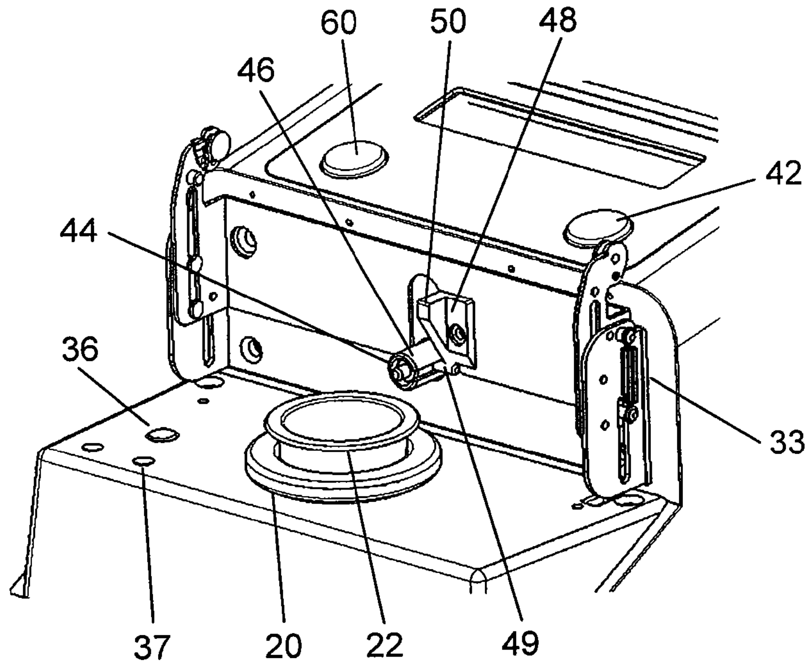


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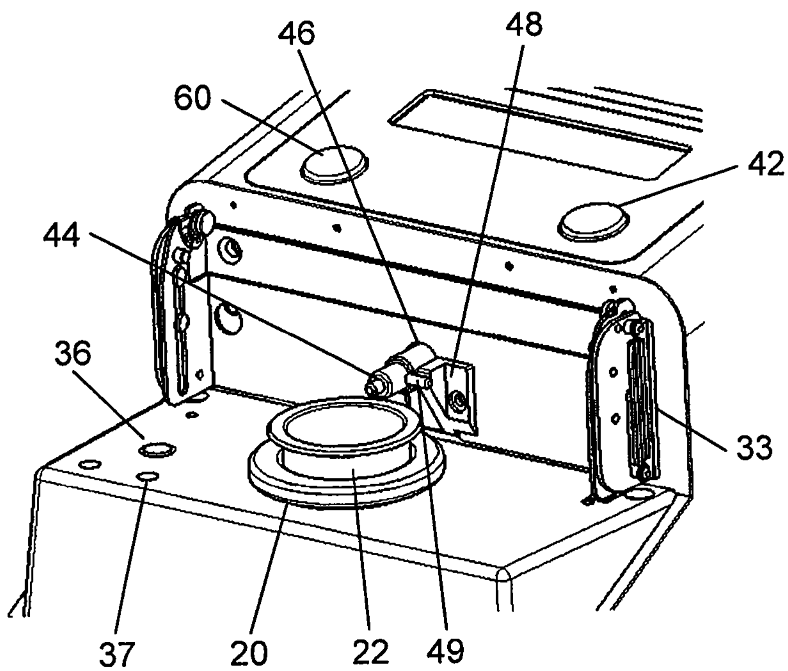


FIG. 33A

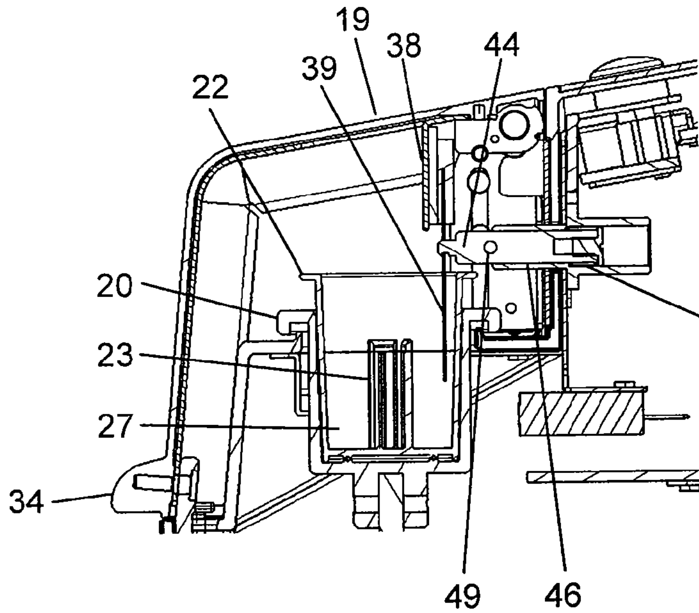



FIG. 33B

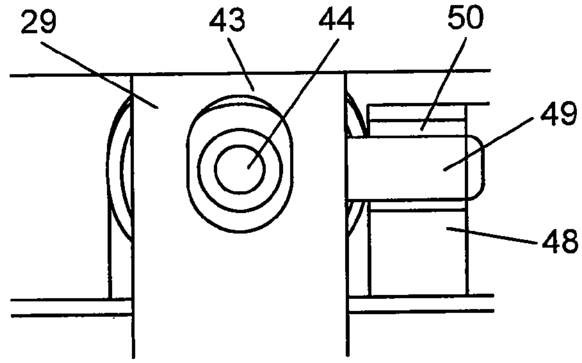



FIG. 33C

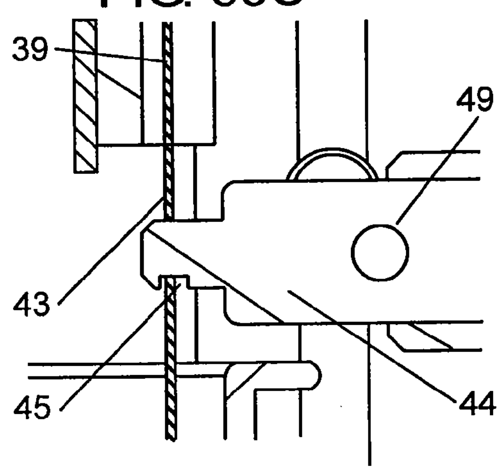
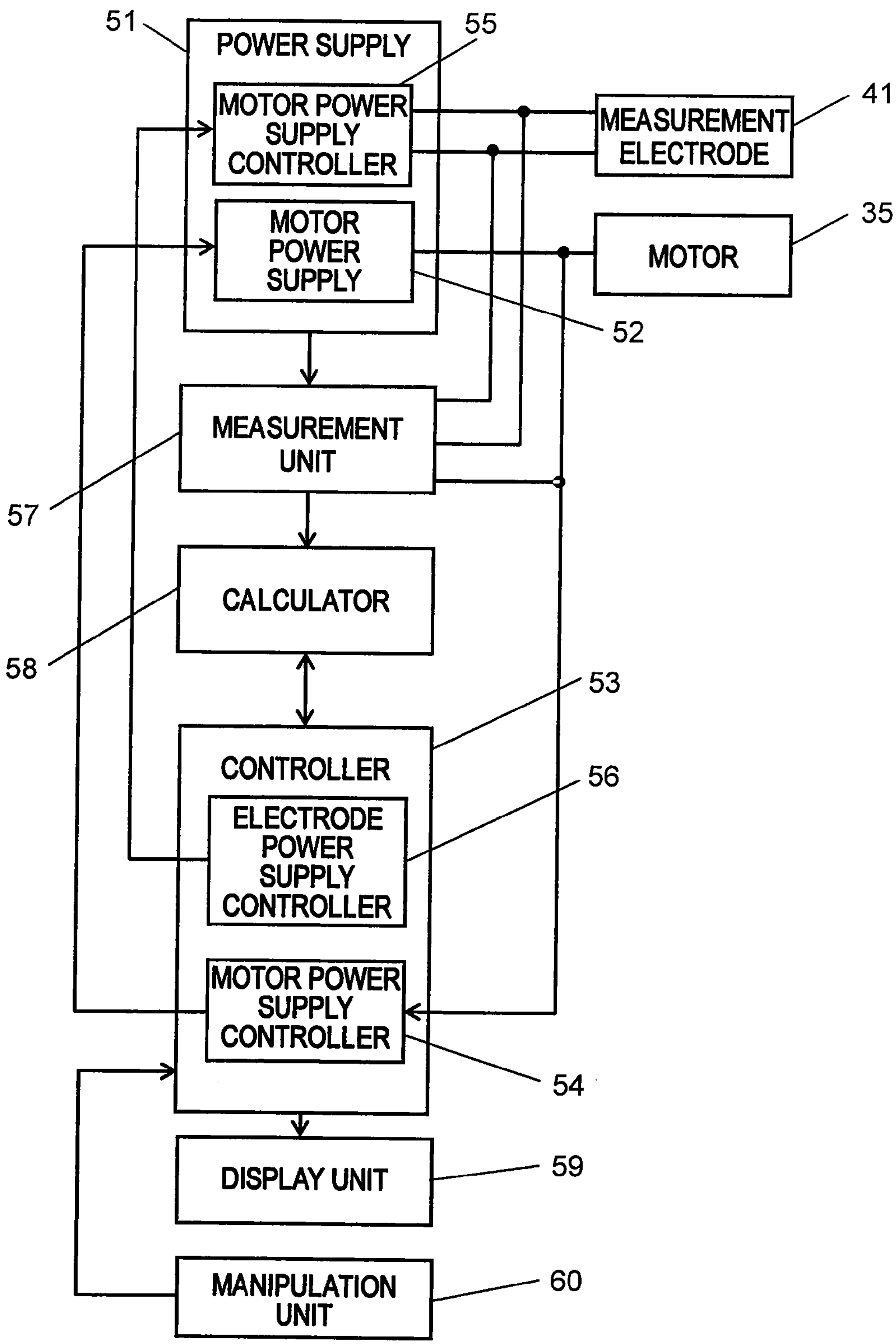


FIG. 34



51
POWER SUPPLY
55
MOTOR POWER SUPPLY CONTROLLER
MEASUREMENT ELECTRODE
41
MOTOR POWER SUPPLY
MOTOR
35
52
MEASUREMENT UNIT
57
CALCULATOR
58
53
CONTROLLER
56
ELECTRODE POWER SUPPLY CONTROLLER
MOTOR POWER SUPPLY CONTROLLER
54
DISPLAY UNIT
59
MANIPULATION UNIT
60

FIG. 35A

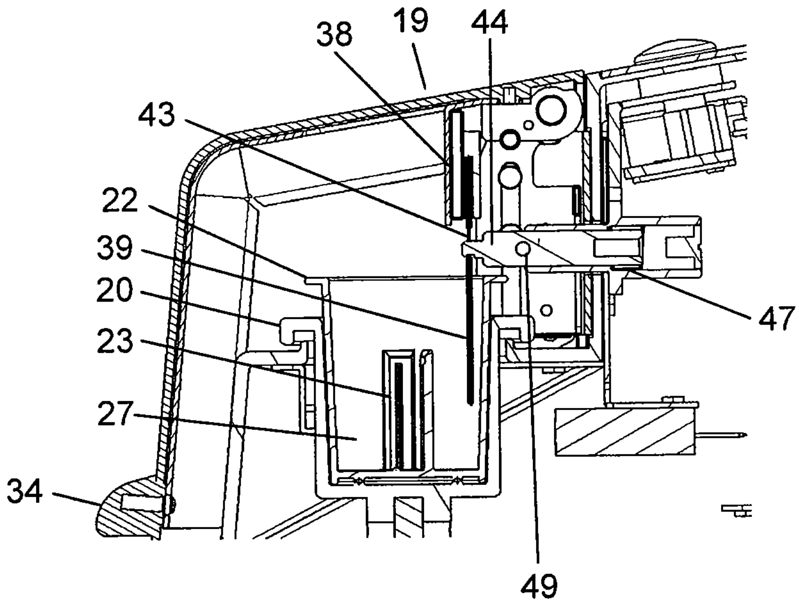



FIG. 35B

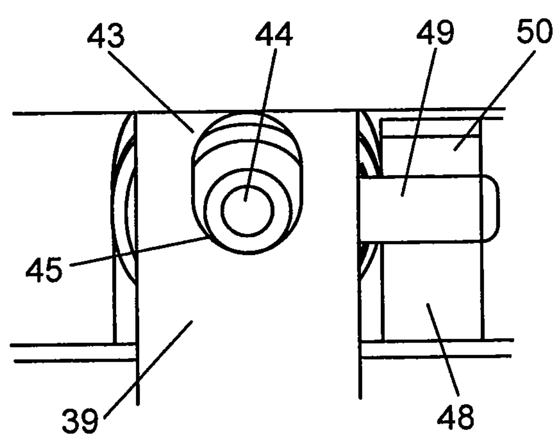


FIG. 36A

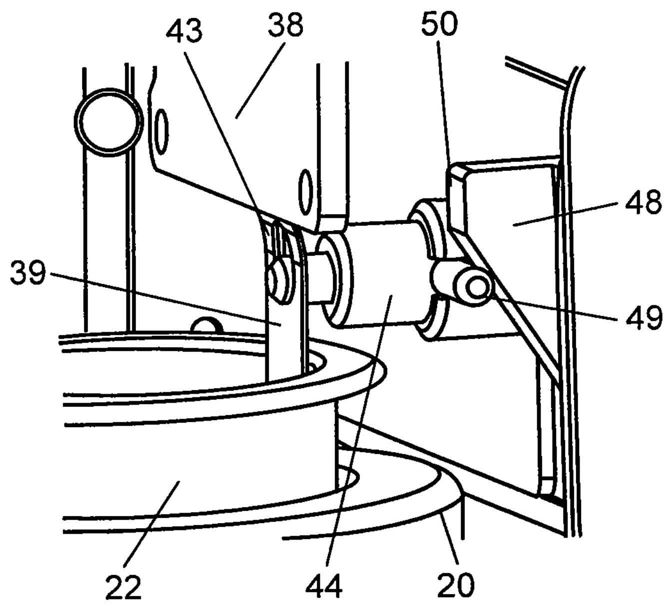



FIG. 36B

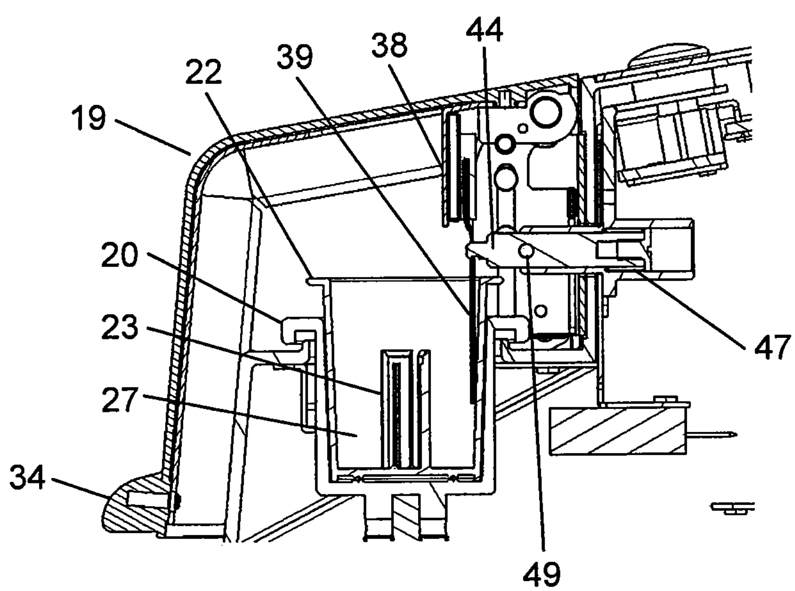


FIG. 37

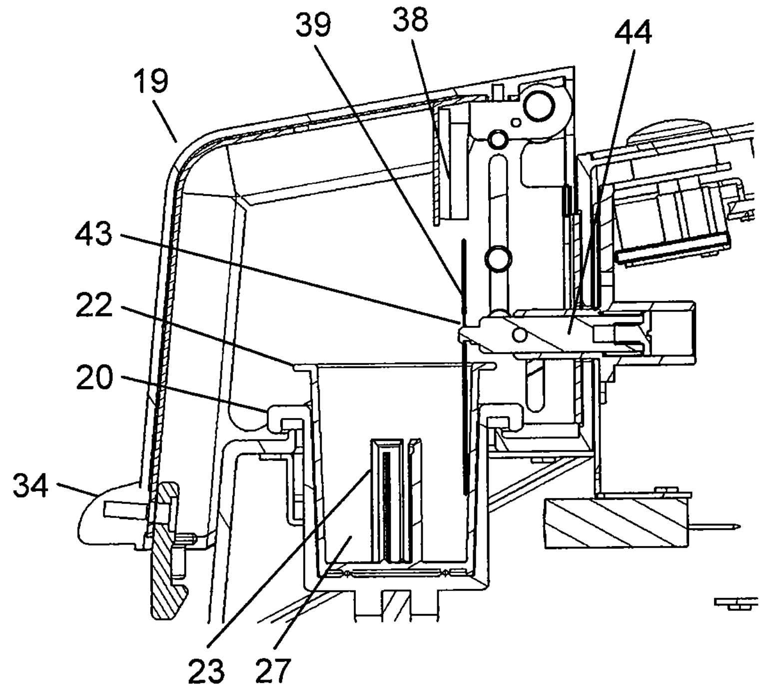


FIG. 38A

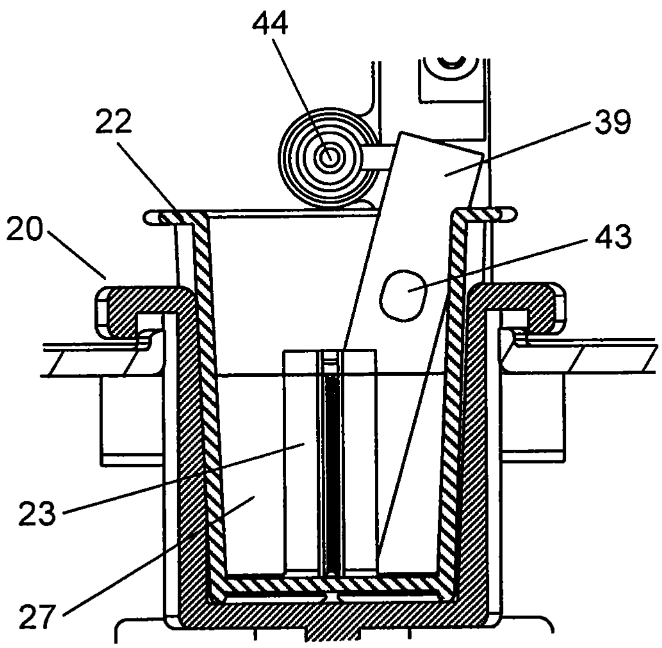



FIG. 38B

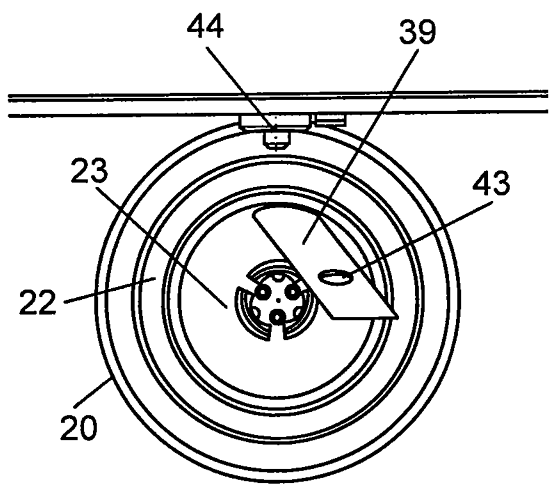


FIG. 39

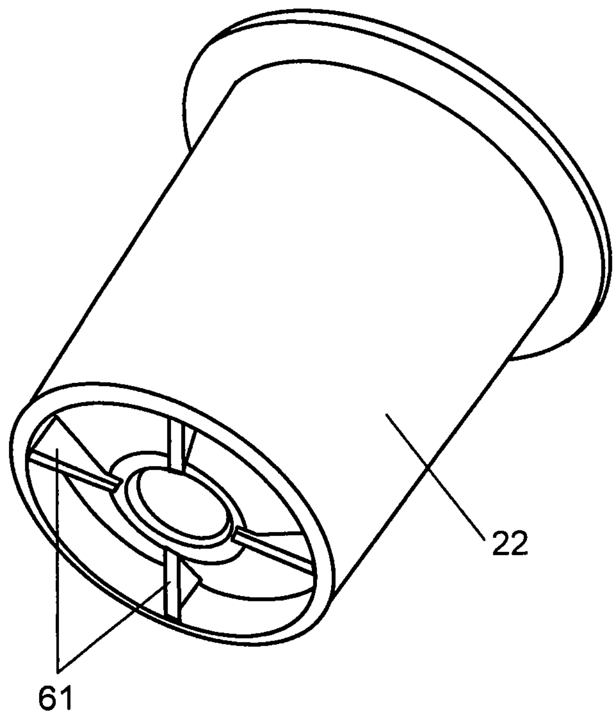


FIG. 40

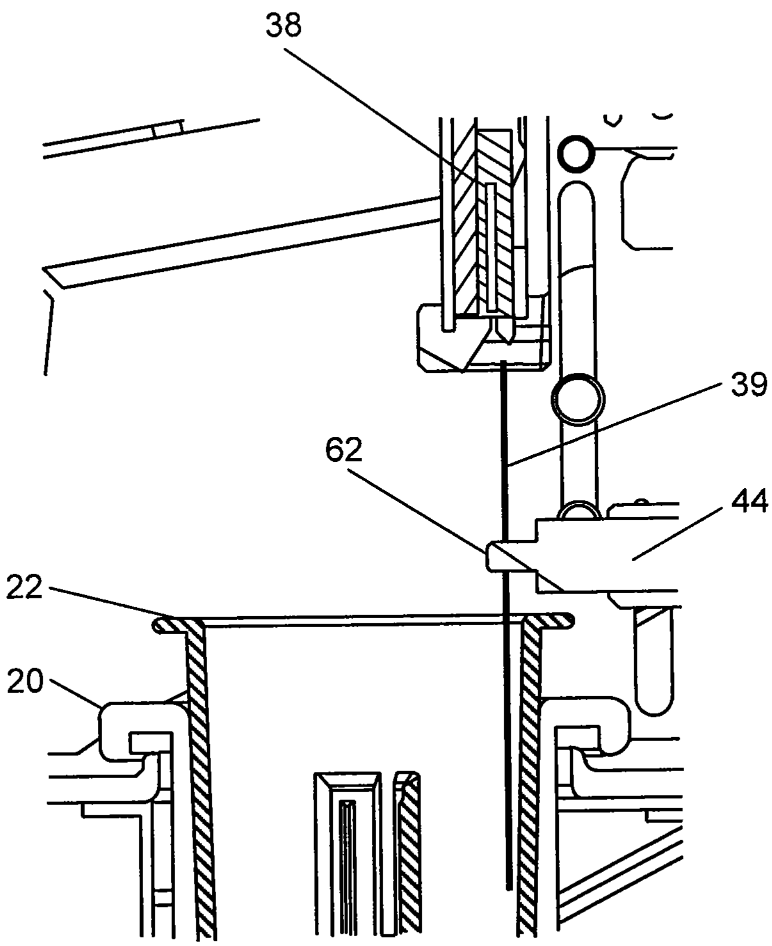
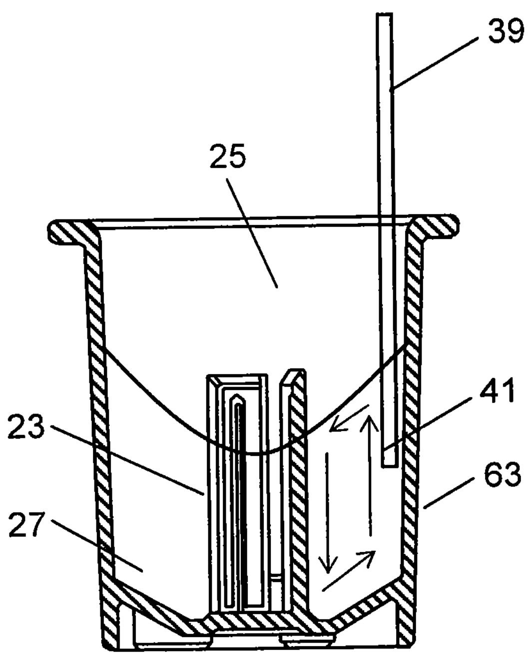


FIG. 41



# MICROBIAL COUNTING CELL, MICROBE COUNTING DEVICE USING SAME, AND MICROBE COUNTING METHOD USING SAME

## TECHNICAL FIELD

The present invention relates to a microorganism counting cell that measures, for example, the number of microorganisms existing in an oral cavity or the number of microorganisms adhering to food.

## BACKGROUND ART

Conventionally, this kind of microorganism counting cell has the following structure.

Specifically, the microorganism counting cell includes a bottomed cylindrical vessel that is provided with an upper surface opening, and a rotor that is provided on the vessel. In a configuration of the microorganism counting cell, a collecting element that is provided on a lower end portion of a rod-shaped microorganism collecting tool is inserted from the upper surface opening of the vessel, and the rotor provided on a bottom surface in the vessel is rotated to strike the collecting element, thereby eluting the microorganisms of the collecting element in a liquid of the vessel (for example, see PTL 1).

Then, the number of microorganisms eluted in the liquid is measured.

Here, the liquid is previously put in the vessel, or the liquid is put in the vessel after the collecting element provided on the lower end portion of the microorganism collecting tool is inserted in the vessel.

In the conventional microorganism counting cell, usefully the microorganisms of the collecting element are eluted in the liquid such that the rotor is rotated to strike the collecting element. However, unfortunately it takes a long time to strike the collecting element to take out the microorganisms from the collecting element, and therefore an elution time is lengthened.

That is, in the conventional microorganism counting cell, the microorganisms are eluted in the liquid of the vessel such that the rotor provided on the bottom surface in the vessel is rotated to strike the rod-shaped microorganism collecting tool, a lower portion of the collecting element is struck by the rotor provided on the bottom surface in the vessel, and sometimes many microorganisms are collected from an intermediate portion to an upper portion of the collecting element depending on a collecting state of a user.

Therefore, it takes a long time to elute the microorganisms from the portion that is not struck by the rotor. The present invention is devised to shorten the microorganism elution time.

## CITATION LIST

### Patent Literature

PTL 1: Unexamined Japanese Patent Publication No. 2009-210488

## SUMMARY OF THE INVENTION

A microorganism counting cell of the present invention includes: a bottomed cylindrical vessel that includes an upper surface opening; and a cylindrical retaining body disposed vertically on a bottom surface in the vessel for receiving a collecting element provided on a lower end portion of a rod-shaped microorganism collecting tool being inserted in the retaining body from the upper surface opening, wherein a plurality of first elution protrusions of a longwall shape formed in an axial direction of the retaining body at predetermined intervals around an interior side surface of the retaining body, and elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions.

## BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **2**A is a side view illustrating a microorganism collecting tool that is used in use of a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **2**B is a sectional view illustrating the microorganism collecting tool that is used in use of the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **2**C is a sectional view illustrating the microorganism collecting tool that is used in use of the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **3**A is a longitudinal sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **3**B is a top view illustrating the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **4** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in an unused state.

FIG. **5** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention when viewed from below.

FIG. **6** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **7** is a sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **8** is an enlarged top view illustrating a main part of a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **9** is an enlarged sectional view illustrating a main part of a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **10** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **11** is a sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **12**A is a top view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **12**B is a longitudinal sectional view illustrating the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **13** is a sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in use.

FIG. **14** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention when viewed from below.

FIG. **15** is a perspective view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **16** is a perspective view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **17** is a perspective view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **18** is a perspective view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **19** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **20**A is a side view illustrating a microorganism collecting tool that is used in use of a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **20**B is a sectional view illustrating the microorganism collecting tool that is used in use of the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **20**C is a sectional view illustrating the microorganism collecting tool that is used in use of the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **21**A is a longitudinal sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention.

FIG. **21**B is a top view illustrating the microorganism counting cell according to the exemplary embodiment of the present invention.

FIG. **22** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in an unused state.

FIG. **23** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention when viewed from below.

FIG. **24** is a perspective view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **25** is a sectional view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **26** is a top view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **27** is a front view illustrating a measurement chip that is used in use of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **28** is a sectional view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **29** is a sectional view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **30** is a sectional view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **31** is a perspective view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **32** is a perspective view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **33**A is a sectional view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **33**B is an enlarged view illustrating the main part of the microorganism counter according to the exemplary embodiment of the present invention.

FIG. **33**C is a sectional view illustrating the main part of the microorganism counter according to the exemplary embodiment of the present invention.

FIG. **34** is a control block diagram illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **35**A is a sectional view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **35**B is an enlarged view illustrating the main part of the microorganism counter according to the exemplary embodiment of the present invention.

FIG. **36**A is a perspective view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **36**B is a sectional view illustrating the main part of the microorganism counter according to the exemplary embodiment of the present invention.

FIG. **37** is a sectional view illustrating a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **38**A is a sectional view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **38**B is a top view illustrating the main part of the microorganism counter according to the exemplary embodiment of the present invention.

FIG. **39** is a perspective view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention when viewed from below.

FIG. **40** is a sectional view illustrating a main part of a microorganism counter according to an exemplary embodiment of the present invention.

FIG. **41** is a sectional view illustrating a microorganism counting cell according to an exemplary embodiment of the present invention in measurement.

## DESCRIPTION OF EMBODIMENTS

### First Exemplary Embodiment

Hereinafter, by way of example, an exemplary embodiment of the present invention applied to a microorganism counting cell that measures the number of microorganisms (bacteria) existing in an oral cavity will be described below with reference to the drawings.

Referring to FIG. **1**, bottomed cylindrical vessel **1** is made of a synthetic resin such as polycarbonate, and circular upper surface opening **2** is formed in an upper surface of vessel **1**.

Rod-shaped microorganism collecting tool illustrated in FIGS. **2**A to **2**C such as cotton swab **3** is inserted in upper surface opening **2**. Cylindrical retaining body **5** disposed vertically on a bottom surface of vessel **1**, and collecting element **4** provided on a lower end portion of inserted cotton swab **3** is inserted in cylindrical retaining body **5**. In order to facilitate the insertion of collecting element **4** of cotton swab

3, the upper surface of cylindrical retaining body **5** constitutes a circular opening in which an obstacle such as a beam does not exist.

In cotton swab **3**, as illustrated in FIGS. **2**A and **2**B, cotton collecting element **4** is provided on a lower end portion of rod **3***a*, and swab portion **4***a* having a diameter larger than that of rod **3***a* is formed at a lower end of collecting element **4**.

FIG. **3**A is a longitudinal sectional view of vessel **1**, and FIG. **3**B is a top view of vessel **1**. As illustrated in FIGS. **3**A and **3**B, retaining body **5** includes a plurality of (three) side surface bodies **5***a* disposed vertically at predetermined equal intervals on a bottom surface of vessel **1** and a plurality of (three) longwall-shaped elution protrusions **7** that are provided on an axial direction of retaining body **5** in interior side surfaces of side surface bodies **5***a*.

Among the plurality of (three) side surface bodies **5***a* constituting retaining body **5**, a plurality of (three) elution grooves **6** each of which pierces retaining body **5** from the inside to the outside are formed into a thin, long groove from the bottom surface to upper surface of retaining body **5**.

That is, the side surface of retaining body **5** extends in the axial direction of retaining body **5**, and the side surface is divided into three side surface bodies **5***a* while sandwiched among three elution grooves **6** disposed at predetermined equal intervals. In the inner side surfaces of side surface bodies **5***a*, elution protrusions **7** are provided on central portions in a circumferential direction of side surface body **5***a*, respectively.

As illustrated in FIG. **3**B, in an interior bottom surface of retaining body **5**, a plurality of (three) elution protrusions **8** are provided circularly at equal intervals around an axis center of retaining body **5**. Elution protrusion **8** is formed into a hemispherical shape while an upper-surface side of elution protrusion **8** has a spherical surface.

A measurement liquid (for example, pure water **9**) is stored in vessel **1** as illustrated in FIG. **3**A, and aluminum cover body **11** is detachably welded to step portion **10** formed in upper surface opening **2** of vessel **1** in order to seal vessel **1** as illustrated in FIG. **4**. Vessel **1** is retained and managed while sealed.

As illustrated in FIG. **5**, on the outside of the bottom surface of vessel **1**, two fixing holes **1***a* that does not pierce the bottom portion of vessel **1** are symmetrically made with respect to the center axis of cylindrical vessel **1** as a fixing portion for fixing vessel **1** to an external device.

FIGS. **6** to **11** illustrate a state in which a measurer elutes microorganisms (bacteria) included in cotton swab **3** in a microorganism counting cell of the first exemplary embodiment. First, the measurer detaches cover body **11** (FIG. **4**) that covers upper surface opening **2** of vessel **1** from vessel **1**, and mounts vessel **1** on mounting unit **13** provided on the upper surface of vessel support **12** as illustrated in FIG. **6**.

As illustrated in FIG. **7**, two projections **13***a* provided on the inner bottom portion of mounting unit **13** are fitted in two fixing holes **1***a* made on the outside of the bottom surface of vessel **1**, thereby mounting vessel **1** on mounting unit **13**.

Then, the measurer traces a tongue of a subject to collect the bacteria in the oral cavity with collecting element **4** provided on the lower end portion of rod **3***a* of cotton swab **3** in FIG. **2**.

Then, the measurer inserts collecting element **4** in cylindrical retaining body **5** from upper surface opening **2** of vessel **1** as illustrated in FIG. **7**.

FIG. **8** is a view illustrating the state in which collecting element **4** of cotton swab **3** is inserted in retaining body **5** when viewed from above. Cylindrical retaining body **5** is configured such that the side surface of collecting element **4** of cotton swab **3** is retained while abutting on three elution protrusions **7** provided on the interior side surfaces of side surface bodies **5***a* constituting retaining body **5**.

Therefore, collecting element **4** is inserted while abutting on three longwall-shaped elution protrusions **7** provided on the inner wall surfaces of side surface bodies **5***a*, and the measurer is guided by three longwall-shaped elution protrusions **7** while feeling insertion resistances of elution protrusions **7** through rod **3***a* of cotton swab **3**, whereby the measurer inserts collecting element **4** in retaining body **5**.

As a result, the side surface of collecting element **4** of cotton swab **3** is firmly retained at equal intervals by three longwall-shaped elution protrusions **7** that are provided on the axial direction of retaining body **5**.

At this point, as illustrated in FIG. **9**, collecting element **4** is retained by retaining body **5** while dipped in pure water **9** of vessel **1**.

As can be seen from FIG. **9**, when collecting element **4** is inserted in retaining body **5**, a side portion from the lower portion to intermediate portion of collecting element **4** abuts on elution protrusions **7**. At this point, collecting element **4** is swollen by containing pure water **9**, and the whole side portion from the lower portion to upper portion of collecting element **4** abuts on longwall-shaped elution protrusions **7** that are provided on the inner wall surfaces of side surface bodies **5***a* while a frictional force is increased.

The side portion of collecting element **4** abuts firmly on longwall-shaped elution protrusions **7**. For example, when rod **3***a* is held to lift cotton swab **3**, the side portion of collecting element **4** abuts so firmly on longwall-shaped elution protrusions **7** that vessel **1** retaining pure water **9** is lifted while attached to cotton swab **3**.

Then, as illustrated in FIG. **10**, when the lower portion of rotation tool **14** is placed from above cotton swab **3** so as to abut on the upper surface of vessel support **12**, the upper portion of cotton swab **3** is inserted while forced against cotton swab mounting unit **15** in rotation tool **14** as illustrated in FIG. **11**.

The upper portion of cotton swab **3** is retained by cotton swab mounting unit **15**, and cotton swab **3** is mounted on rotation tool **14** connected to cotton swab mounting unit **15**.

When cotton swab **3** is mounted on rotation tool **14**, because cotton swab **3** is pushed down by cotton swab mounting unit **15**, swab portion **4***a* formed at the lower end of collecting element **4** of cotton swab **3** is pushed down toward the interior bottom surface of retaining body **5**, and swab portion **4***a* abuts firmly on three elution protrusions **8** (FIG. **3**B) provided on the interior bottom surface while being compressed between the interior bottom surface of vessel **1** and the lower end portion of rod **3***a*.

When switch **16** of rotation tool **14** is pressed in this state, motor **17** in rotation tool **14** rotates, cotton swab **3** rotates through cotton swab mounting unit **15**, and collecting element **4** provided on the lower end portion of cotton swab **3** rotates in retaining body **5**.

At this point, in retaining body **5**, the whole side portion from the lower portion to upper portion of collecting element **4** is retained by abutting on longwall-shaped elution protrusions **7** formed in three side surface bodies **5***a* from three directions at predetermined equal intervals.

Therefore, collecting element **4** rotates stably while being retained equal intervals by abutting on elution protrusions **7** from the three directions, and the whole side portion of collecting element **4** are sequentially scrubbed to longwall-shaped elution protrusions **7** provided on three side surface bodies **5***a*. The scrub elutes the bacteria from collecting element **4** such that the bacteria collected by collecting element **4** are scraped.

At this point, the whole side portion of collecting element **4** abuts on elution protrusion **7**, and the portion from the intermediate portion to lower portion of collecting element **4** is enlarged compared with the upper portion of collecting element **4** as illustrated in FIG. **2**.

Due to this, at the beginning of the rotation, the portion from the intermediate portion to lower portion of collecting element **4** is strongly scrubbed to elution protrusion **7** compared with the upper portion of collecting element **4**. Therefore, the cotton constituting collecting element **4** moves toward the upper portion having a low scrubbing pressure along the side portion of rod **3***a*.

When cotton swab **3** continuously rotates to scrub collecting element **4** to elution protrusion **7**, collecting element **4** is deformed such that the scrubbing pressure between collecting element **4** and elution protrusion **7** is uniformed in the side portion of collecting element **4**, namely, a thickness of the cotton is kept constant. The cotton in which the thickness is kept constant by the deformation is scrubbed to longwall-shaped elution protrusion **7**, and the bacteria elution is promoted by applying the substantially same force from the lower portion to upper portion of collecting element **4**, thereby efficiently eluting the bacteria.

When the scrub is further continued in this state, the cotton of collecting element **4** is wrung around rod **3***a* with a uniform thickness, and the bacteria collected in the cotton are finally eluted into pure water **9** so as to be squeezed from collecting element **4**.

On the other hand, as illustrated in FIG. **8**, swab portion **4***a* formed at the lower end of collecting element **4** is compressed between the interior bottom surface of retaining body **5** and the lower end portion of rod **3***a*, and abuts on three hemispherical elution protrusions **8** provided on the interior bottom surface.

Therefore, when collecting element **4** rotates, swab portion **4***a* is sequentially scrubbed to three elution protrusions **8**, and the scrub can elite the bacteria collected by swab portion **4***a* from collecting element **4** in a short period of time.

At this point, the cotton constituting swab portion **4***a* moves in the direction of the side portion of rod **3***a* having the low scrubbing pressure.

When swab portion **4***a* is continuously scrubbed to elution protrusions **8** in this state, the cotton of swab portion **4***a* and the cotton in the side portion of collecting element **4** are scrubbed to longwall-shaped elution protrusions **7** in the side portion of rod **3***a*.

Finally, as illustrated in FIG. **2**C, swab portion **4***a* is scrubbed to elution protrusions **8** and eliminated.

On the other hand, the cotton of collecting element **4** is also wrung until wound around rod **3***a* with the uniform thickness.

As a result, all the bacteria collected by collecting element **4** are eluted to the outside of collecting element **4**.

As illustrated in FIGS. **8** and **9**, because thin, long elution groove **6** is provided from the bottom surface to upper surface in the side surface of retaining body **5**, the bacteria eluted from collecting element **4** go out from retaining body **5** through nearest elution groove **6** facing collecting element **4**, and the bacteria can be immediately eluted into pure water **9** of vessel **1**.

At this point, it is necessary that almost all the bacteria included in collecting element **4** be taken out in order to measure, for example, the number of microorganisms existing in the oral cavity or the number of microorganisms adhering to food.

In the first exemplary embodiment, as described above, when collecting element **4** rotates while being inserted in retaining body **5**, the whole side portion from the lower portion to upper portion of collecting element **4** abuts on longwall-shaped elution protrusions **7** formed in three side surface bodies **5***a* in retaining body **5**.

Accordingly, when collecting element **4** continuously rotates, the whole side portion of collecting element **4** is sequentially scrubbed to longwall-shaped elution protrusions **7** provided on three side surface bodies **5***a*. Almost all the bacteria of collecting element **4** can be eluted into pure water **9** of vessel **1** in a short period of time by the scrub.

As a result, the bacteria can efficiently be taken out from collecting element **4** to shorten the bacteria elution time.

Then, when the rotation of motor **17** in FIG. **11** is stopped to lift rotation tool **14**, cotton swab **3** mounted on rotation tool **14** can easily be extracted from retaining body **5** for the following reason.

Before the elution, collecting element **4** of cotton swab **3** abuts firmly on retaining body **5**. In order to elute the bacteria, when cotton swab **3** is rotated to scrub collecting element **4** to elution protrusion **7** and elution protrusion **8**, collecting element **4** is wrung and wound around rod **3***a* as illustrated in FIG. **2**C.

In this state, because collecting element **4** of cotton swab **3** is not already retained by retaining body **5**, cotton swab **3** can easily be extracted from retaining body **5**.

Then, vessel **1** including pure water **9** in which the bacteria are eluted is taken out from vessel support **12**, and vessel **1** is set in a measurement instrument (not illustrated) to measure the number of bacteria.

In the first exemplary embodiment, elution protrusions **8** are provided on the interior bottom surface of retaining body **5** in addition to three longwall-shaped elution protrusions **7** provided on the inner wall surfaces of side surface bodies **5***a*. Alternatively, because the bacteria can sufficiently be eluted into pure water **9** only by elution protrusions **7**, elution protrusions **8** may be eliminated from the interior bottom surface of retaining body **5** as illustrated in FIGS. **12**A and **12**B.

Other features of the first exemplary embodiment will be described below.

In the first exemplary embodiment, as described above, the side surface of retaining body **5** is divided into three side surface bodies **5***a*, and side surface bodies **5***a* are configured to be vertically provided on the bottom surface of vessel **1**.

When rod-shaped cotton swab **3** is rotated at a high speed of, for example, 100 rps, sometimes cotton swab **3** is rotated while deviated from the rotation center by a centrifugal force. Even such cases, side surface body **5***a* is fixed to the bottom surface of vessel **1** only at the lower end, so that the upper portion of vessel **1** can be deflected toward the outside of the rotation center.

Therefore, side surface body **5***a* properly allows an excessive pressure generated by the rotation of cotton swab **3** to escape, and collecting element **4** can be scrubbed to elution protrusions **7** with a proper pressure.

As described above, because the excessive pressure is not partially applied to collecting element **4** of cotton swab **3**, the cotton of collecting element **4** is not broken by elution protrusions **7**, and the cotton does not go out into pure water **9**. Therefore, the broken cotton of collecting element **4** does not adversely affect the measurement of the number of bacteria, which is performed after the bacteria elution.

As a result, the bacteria can be eluted from collecting element **4** in a short period of time, for example, 10 seconds to shorten the bacteria elution time.

As illustrated in FIG. **5**, on the outside of the bottom surface of vessel **1**, two fixing holes **1***a* are symmetrically made with respect to the center axis of cylindrical vessel **1** as a fixing portion for fixing vessel **1** to the external device. Two projections **13***a* provided on the inner bottom portion of mounting unit **13** of vessel support **12** in FIG. **7** are fitted in two fixing holes **1***a*. Therefore, even when cotton swab **3** is rotated at a high speed of, for example, 100 rps, the rotation of vessel **1** can be prevented without being affected from the rotation of cotton swab **3**.

As a result, rotating cotton swab **3** can firmly be scrubbed to elution protrusions **7** of three still side surface bodies **5***a* to shorten the bacteria elution time.

Further, in the first exemplary embodiment, the plurality of (three) elution protrusions **8** are provided at equal intervals on the circle around the axis center of retaining body **5** in the interior bottom surface of retaining body **5** of vessel **1**.

Swab portion **4***a* in the lower end portion of rod **3***a* of cotton swab **3** is forced against three elution protrusions **8**. Therefore, swab portion **4***a* is retained by three elution protrusions **8** in the bottom surface.

When cotton swab **3** is rotated, the lower end portion of rod **3***a* that forces swab portion **4***a* against three elution protrusions **8** is rotated while guided to the axis center of retaining body **5** by three elution protrusions **8**.

Particularly, because three elution protrusions **8** are formed into the hemispherical shape, the lower end portion of rod **3***a* is smoothly guided to the axis center of retaining body **5** by utilizing a curved surface of the hemisphere.

The rotation of cotton swab **3** can be stabilized by the above configuration.

As a result, because of the stabilization of the rotation of cotton swab **3**, the bacteria can be eluted, and the bacteria elution time can be shortened.

In the first exemplary embodiment, the measurement of the number of bacteria existing in the oral cavity is described by way of example. The present invention can also be applied to the microorganism counting cell that measures the number of microorganisms adhering to the food.

In the first exemplary embodiment, rod **3***a* of cotton swab **3** is rotated. Alternatively, as illustrated in FIG. **13**, rod **3***a* of cotton swab **3** may be taken between fingers to rotate vessel **1**.

That is, even if vessel **1** is rotated instead of rotating cotton swab **3**, because elution protrusions **7** of retaining body **5** can be scrubbed to collecting element **4** of cotton swab **3**, the bacteria collected by collecting element **4** of cotton swab **3** can be eluted into pure water **9** in a short period of time similarly to the first exemplary embodiment.

In rotating vessel **1**, four ribs **1***b* are provided at 90-degree intervals on the outside of the bottom surface of vessel **1** as illustrated in FIG. **14**, and driving protrusions **1***d* of vessel retaining unit is that is provided as a component of a rotation driving unit illustrated in FIGS. **13** and **15** are coupled to the ribs **1***b*.

Ribs **1***b* formed outside the bottom surface of vessel **1** constitutes a coupling unit coupled to the driving protrusions **1***d* of the rotation driving unit that rotates vessel **1**.

Because two driving protrusions **1***d* are provided at 180-degree intervals as illustrated in FIG. **15**, the driving protrusions **1***d* can normally (clockwise) rotate vessel **1** by abutting on rib **1***b* existing in the rotation direction when vessel retaining unit **1***c* is normally rotated by motor **1***e* in FIG. **13** that is provided as a component of the rotation driving unit.

When motor **1***e* is reversely (counterclockwise) rotated, the driving protrusions **1***d* can reversely rotate vessel **1** by abutting on rib **1***b* on the opposite side.

The elution by the normal and reverse rotations will be described in detail.

As illustrated in FIG. **13**, for example, motor **1***e* is normally rotated for 1 second at 7 rps while vessel **1** is retained in vessel retaining unit **1***c*. Then, motor **1***e* is reversely rotated for 1 second at 7 rps. The normal and reverse rotation operations are performed for 30 seconds in total.

During the normal and reverse rotation operations, in retaining body **5**, as described above, the whole side portion from the lower portion to upper portion of collecting element **4** is retained by abutting on longwall-shaped elution protrusions **7** formed in three side surface bodies **5***a* from three directions at equal intervals. The whole side portion of collecting element **4** is sequentially scrubbed to longwall-shaped elution protrusions **7** provided on three side surface bodies **5***a*.

More specifically, the direction in which collecting element **4** scrubs elution protrusion **7** becomes reverse when vessel **1** changes from the normal rotation to the reverse rotation or the reverse rotation to the normal rotation. Therefore, the whole side portion of collecting element **4** is unhardened once by elution protrusions **7**, and pure water **9** invades in collecting element **4**. When rotated for 1 second at 7 rps, collecting element **4** is scrubbed in the same direction to elution protrusions **7**, and the bacteria of collecting element **4** are efficiently eluted along with pure water **9** invading in collecting element **4**.

Then, for example, motor **1***e* is normally rotated for 10 seconds at 7 rps. As described above, the cotton of collecting element **4** is deformed by the continuously normal rotation such that the thickness of the cotton is kept constant. The cotton that becomes the constant thickness by the deformation is scrubbed to and wrung by longwall-shaped elution protrusions **7**, and the bacteria remaining finally in collecting element **4** are eluted.

Finally, as illustrated in FIG. **2**C, swab portion **4***a* is scrubbed to elution protrusion **8** and eliminated, and the cotton of collecting element **4** is wrung to an extent that the cotton is wound around rod **3***a* with the uniform thickness.

As a result, almost all the bacteria collected by collecting element **4** (for example, in the first exemplary embodiment, the bacteria of 85% or more) can be eluted to the outside of collecting element **4** in a short period of time to shorten the elution time of the bacteria (microorganisms).

Then, the number of eluted bacteria is measured.

In the first exemplary embodiment, as illustrated in FIG. **3**B, odd-numbered (three) side surface bodies **5***a* are provided around the side surface of retaining body **5**. A width in the horizontal direction of side surface body **5***a* is larger than a width in the horizontal direction of elution groove **6**.

Therefore, collecting element **4** can stably be rotated.

Because odd-numbered (three) side surface bodies **5***a* are provided around the side surface of retaining body **5**, side surface body **5***a* is disposed opposite elution groove **6** across the rotating shaft of vessel **1** as illustrated in FIG. **3**B.

Therefore, during the rotation of retaining body **5**, even if collecting element **4** of cotton swab **3** is deviated from the rotating shaft of retaining body **5** to oscillate in the horizontal direction, elution grooves **6** do not exist on both sides in the oscillation direction of collecting element **4** of cotton swab **3**. That is, collecting element **4** abuts on side surface body **5***a* having the width larger than that of elution groove **6** on at least one side in the oscillation direction, and collecting element **4** is returned to the rotating shaft side.

As a result, collecting element **4** can stably be rotated.

The width of elution groove **6** in the circumferential direction is smaller than the thickness of rod **3***a* of cotton swab **3**.

Therefore, collecting element **4** of cotton swab **3** does not fall out to the outside of retaining body **5** through elution groove **6** of retaining body **5**.

In the first exemplary embodiment, as illustrated in FIG. **3**A, side surface bodies **5***a* constituting retaining body **5** are vertically disposed on the bottom surface of vessel **1**. A space from the outer wall surfaces of side surface bodies **5***a* constituting retaining body **5** to the inner wall surface of vessel **1** constitutes an elution region where the bacteria is eluted into pure water.

A measurement electrode (not illustrated) of a measurement chip (not illustrated) that measures the number of bacteria can be inserted and dipped in the elution region from the outer wall surfaces of side surface bodies **5***a* to the inner wall surface of vessel **1**. That is, when the number of bacteria is measured using the measurement electrode (not illustrated), because the elution region can be used as the measurement region, convenience is enhanced.

As described above, the microorganism counting cell of the first exemplary embodiment includes bottomed cylindrical vessel **1** that includes upper surface opening **2** and cylindrical retaining body **5** disposed vertically on the bottom surface in vessel **1** and includes the plurality of side surface bodies **5***a* in which collecting element **4** provided on the lower end portion of cotton swab **3** is inserted from upper surface opening **2**, elution protrusions **7** are provided on the interior side surfaces of side surface bodies **5***a*, and elution grooves **6** each of which pierces retaining body **5** from the inside to the outside are formed among the plurality of side surface bodies **5***a*. Therefore, the bacteria elution time can be shortened.

That is, in the first exemplary embodiment, because cylindrical retaining body **5** is vertically disposed on the bottom surface in vessel **1**, collecting element **4** provided on the lower end portion of cotton swab **3** is inserted from upper surface opening **2** of vessel **1**.

At this point, elution protrusions **7** are provided on the interior side surfaces of side surface bodies **5***a* constituting retaining body **5**, and elution grooves **6** that pierce retaining body **5** from the inside to the outside are provided around the side surface of retaining body **5**. Therefore, elution protrusions **7** abut on the lower portion to upper portion of collecting element **4**, thereby eluting the bacteria from the whole portion from the lower portion to upper portion of collecting element **4**. As a result, the elution time of the bacteria (microorganisms) can be shortened.

The eluted bacteria can be eluted to the outside of retaining body **5** through elution grooves **6**, namely, to pure water **9** in vessel **1**, so that the subsequent measurement can easily be performed.

Accordingly, the microorganism counting cell of the first exemplary embodiment is expected to be widely used as the microorganism counting cell that measures the number of microorganisms existing in the oral cavity or the number of microorganisms adhering to the food.

## Second Exemplary Embodiment

As illustrated in FIG. **16**, front surface cover **19** in FIGS. **17** and **18** is provided on an openable and closable manner in an upper portion of a front portion of box-shaped body case **18**. An opening and closing structure of front surface cover **19** is described in detail later. In releasing front surface cover **19**, front surface cover **19** is lifted upward as illustrated in FIGS. **16** and **17**, and front surface cover **19** is turned upward as illustrated in FIGS. **17** and **18**, thereby performing an opening operation.

As illustrated in FIG. **18**, vessel retaining unit **20** is provided on body case **18** on a backside of front surface cover **19**, which is exposed by opening front surface cover **19**. As can be seen from FIGS. **18** and **25**, vessel retaining unit **20** is formed into a bottomed cylindrical shape in which an upper surface is opened. As illustrated in FIG. **26**, two driving protrusions **21** are provided so as to face each other at 180-degree intervals in a bottom surface of vessel retaining unit **20**.

As illustrated in FIG. **25**, vessel retaining unit **20** retains an outer circumferential surface and a bottom portion of bottomed cylindrical vessel **22** having the opening in the upper surface.

With respect to vessel **22**, as can be seen from FIGS. **19** and **21**A to **23**, cylindrical retaining body **23** is formed on an interior bottom surface of vessel **22**, three elution protrusions **24** are vertically formed at 120-degree intervals in an interior side surface of retaining body **23**, three elution grooves **25** that pierce retaining body **23** from an inside to an outside are formed at 120-degree intervals in the side surface of retaining body **23** so as to face elution protrusions **24**, and three hemispherical elution protrusions **26** are formed at 120-degree intervals in the bottom portion of retaining body **23**.

Pure water **27** which is a liquid into which the microorganisms are eluted is stored in vessel **22**, and cover **28** is attached to the upper surface opening of vessel **22** such that pure water **27** does not spill over during conveyance as illustrated in FIG. **22**.

As illustrated in FIG. **23**, two protrusions **29** that engage driving protrusions **21** of vessel retaining unit **20** are disposed so as to face each other at 180-degree intervals in a lower portion of the bottom surface of vessel **22**.

Collecting element **31** provided at a lower end of rod-shaped microorganism collecting tool (cotton swab) **30** in FIGS. **20**A to **20**C is inserted from above in retaining body **23** of vessel **22**, and the microorganisms are eluted into pure water **27** while the collecting element **31** is inserted in retaining body **23**. That is, collecting element **31** of microorganism collecting tool **30** is inserted in the oral cavity, and the microorganisms collected by collecting element **31** are eluted into pure water **27**.

The elution of the microorganism into pure water **27** will be described below.

First, manipulation button **32** provided on the lower portion of the front surface of body case **18** in FIG. **16** is pressed in order to start the elution. When manipulation button **32** is pressed, front surface cover **19** is unlocked to slightly lift front surface cover **19** as illustrated in FIG. **17**.

As illustrated in FIG. **32**, springs **33** are mounted on both sides in front surface cover **19** in order to lift front surface cover **19**. As described above, when front surface cover **19** is unlocked, the elongated springs **33** in FIG. **32** are returned to an original state in FIG. **31**, and front surface cover **19** is lifted by a restoring force at that time. FIGS. **31** and **32** illustrate the later-described operation, and front surface cover **19** is not illustrated for the purpose of easy understanding of an operation to lift front surface cover **19**.

After front surface cover **19** is lifted, handle **34** provided at the lower end of the front surface of front surface cover **19** is grasped, front surface cover **19** is lifted and opened, and vessel retaining unit **20** is exposed from body case **18** as illustrated in FIG. **18**.

As illustrated in FIG. **22**, because cover **28** in FIG. **22** is attached to the upper surface opening of vessel **22**, cover **28** is detached from the upper surface opening of vessel **22**. In this state, as illustrated in FIGS. **24** and **25**, vessel **22** is inserted from below in the upper surface opening of vessel retaining unit **20**, whereby the lower portion and outer circumferential portion of vessel **22** are retained by vessel retaining unit **20**.

As illustrated in FIGS. **21**A and **21**B, pure water **27** is stored in vessel **22** retained by vessel retaining unit **20**, and collecting element **31** of microorganism collecting tool **30** in FIG. **20** is inserted in pure water **27**. Before collecting element **31** of microorganism collecting tool **30** in FIGS. **20**A and **20**B is inserted in pure water **27**, collecting element **31** is inserted in the oral cavity to collect the microorganisms in the oral cavity.

As illustrated in FIGS. **24** and **25**, collecting element **31** of microorganism collecting tool **30** is inserted from above in retaining body **23** of vessel **22**. At this point, as illustrated in FIGS. **24** and **25**, because front surface cover **19** is turned behind the space above the upper surface opening of vessel **22**, the work to insert collecting element **31** of microorganism collecting tool **30** in retaining body **23** can extremely easily be performed.

As illustrated in FIGS. **21**A and **23**, protrusion **29** is provided on the lower portion of the bottom surface of vessel **22**. As illustrated in FIG. **26**, driving protrusion **21** is provided on the bottom surface of vessel retaining unit **20** that retains vessel **22**.

Accordingly, when vessel retaining unit **20** is rotated by motor **35** in FIG. **25**, driving protrusion **21** of vessel retaining unit **20** and protrusion **29** in the bottom surface of vessel **22** are engaged with each other to rotate vessel **22**.

Switch **36** in FIG. **18** is pressed to rotate motor **35**. For example, switch **36** is pressed by a left hand while the upper portion of microorganism collecting tool **30** in FIGS. **24** and **25** is picked by fingers of a right hand.

Because microorganism collecting tool **30** is picked by the fingers of the right hand, microorganism collecting tool **30** is retained in a constant state without the rotation. On the other hand, as described above, vessel **22** is rotated by motor **35** through vessel retaining unit **20** for a set timer time (for example, 10 seconds).

At this point, as illustrated in FIGS. **21**A and **21**B, a whole circumference of retaining body **23** of vessel **22** is divided into three portions, elution groove **25** exists in the divided portion, and elution protrusion **24** is provided on an inner circumferential surface. Therefore, a pressure is applied from the outside to collecting element **31** of microorganism collecting tool **30** by rotated elution protrusions **24**. Therefore, the microorganisms (bacteria) collected by collecting element **31** are extremely effectively eluted into pure water **27** in retaining body **23**, and the microorganisms are widely eluted into pure water **27** in vessel **22** through elution groove **25**.

Display lamp **37** in FIG. **24** blinks during the elution, and the blinking of display lamp **37** and the rotation of motor **35** are ended when the timer time elapses.

When the elution operation is ended, both the lower portion and the outer circumferential portion of collecting element **31** of microorganism collecting tool **30** are compressed inward as illustrated in FIG. **20**C. At this point, the retaining force of retaining body **23** hardly works, and therefore collecting element **31** can easily picked out.

FIG. **28** illustrates the state in which microorganism collecting tool **30** is picked out from vessel **22**.

In the second exemplary embodiment, at this point, measurement chip **39** in FIG. **27** is mounted on measurement chip-retaining unit **38** provided on an inner surface of front surface cover **19**.

Specifically, measurement chip **39** is formed into a rectangular plate shape as illustrated in FIG. **27**, connection electrode **40** to measurement chip-retaining unit **38** is provided at an upper end of measurement chip **39**, and measurement electrode **41** is provided at an lower end of measurement chip **39**.

Accordingly, when an intermediate portion of measurement chip **39** is picked to mount connection electrode **40** on measurement chip-retaining unit **38** as illustrated in FIG. **28**, the electrical and mechanical connections are established.

The electrode insertion unit includes front surface cover **19** and measurement chip-retaining unit **38**. As illustrated in FIG. **28**, when front surface cover **19** is lifted and opened, in the electrode insertion unit above vessel **22**, a measurement chip insertion port of measurement chip-retaining unit **38** is oriented upward from a horizontal position.

Therefore, connection electrode **40** of measurement chip **39** can easily be mounted on measurement chip-retaining unit **38** while the measurement chip insertion port of measurement chip-retaining unit **38** is visually checked.

After the state in FIG. **28**, when handle **34** is grasped to turn front surface cover **19** frontward and downward to cover the front surface of body case **18** as illustrated in FIG. **29**, measurement chip **39** is inserted in the upper surface opening of vessel **22**.

When handle **34** is further lowered as illustrated in FIG. **30**, front surface cover **19** is lowered to the state in FIG. **16**, and front surface cover **19** is locked. At this point, measurement electrode **41** of measurement chip **39** is dipped in pure water **27** of vessel **22**.

That is, measurement start switch **42** in FIG. **16** is pressed while measurement electrode **41** of measurement chip **39** is dipped in pure water **27** of vessel **22** by the electrode insertion unit including front surface cover **19** and measurement chip-retaining unit **38**. For example, a 3-MHz voltage is applied to measurement electrode **41** to collect the microorganism eluted in vessel **22** to the portion of measurement electrode **41**. At the same time, for example, an 800-kHz voltage is applied to measurement electrode **41** to measure the number of microorganisms.

Because the measurement of the number of microorganisms is well known by a prior literature, the description is simplified for purposes of clarity of description. In the second exemplary embodiment, during the measurement of the number of microorganisms, vessel retaining unit **20** and vessel **22** are rotated by motor **35** to increase an opportunity of bringing the microorganisms diffused widely in vessel **22** close to measurement electrode **41**.

In the state in which the number of microorganisms is measured using measurement chip **39**, rod-shaped manipulation body **44** constituting a measurement chip separating body is inserted in through-hole **43** in FIG. **27** provided on the intermediate portion of measurement chip **39** as illustrated in FIG. **30**.

This point will be described in detail. As is clear from FIG. **29**, manipulation body **44** is retreated rearward until measurement chip **39** is completely lowered to vessel **22**. As illustrated in FIG. **30**, manipulation body **44** protrudes toward the direction of front surface cover **19** before measurement chip **39** is completely lowered to vessel **22**.

As can be seen from FIGS. **27**, **33**B, and **33**C, because through-hole **43** made in measurement chip **39** is vertically long, manipulation body **44** can protrude even before measurement chip **39** is completely lowered.

As illustrated in FIG. **33**C, hook-shaped engagement portion **45** is provided on a lower surface at a front end of manipulation body **44**, and a lower end side of through-hole **43** of measurement chip **39** is engaged with engagement portion **45** when measurement chip **39** is separated.

In the second exemplary embodiment, the number of microorganisms in vessel **22** can be measured in the state in FIG. **30**. However, as illustrated in FIG. **28**, when front surface cover **19** is opened and closed after the measurement, measurement chip **39** is largely lifted out of vessel **22** along with front surface cover **19**, and measurement chip **39** is in the state in which the measurement is already performed in vessel **22**.

That is, as illustrated in FIG. **28**, when measurement chip **39** is lifted along with front surface cover **19** after the measurement, undesirably pure water **27** containing the microorganisms adhering during the measurement is carelessly spattered or drops onto the front portion or lower portion of front surface cover **19**. Therefore, in the second exemplary embodiment, manipulation body **44** constituting the measurement chip separating body is provided as described above.

This point will further specifically be described in detail. When the number of microorganisms is measured using measurement chip **39**, namely, when measurement electrode **41** of measurement chip **39** is dipped in pure water **27** as illustrated in FIG. **30**, manipulation body **44** is already protruded in through-hole **43** of measurement chip **39**.

The mechanism in FIGS. **31** and **32** causes manipulation body **44** to protrude from the state in FIG. **29** to the state in FIG. **30**, and causes manipulation body **44** to retreat from the state in FIG. **30** to the state in FIG. **29**. Manipulation body **44** is slidably provided on cylindrical guide tube **46**, and guide tube **46** is fixed to body case **18**. In guide tube **46**, manipulation body **44** is always biased in the rear direction opposite to front surface cover **19** by spring **47** in FIG. **29**. FIGS. **29** and **31** illustrate this state.

When front surface cover **19** is further pushed down from the state in FIG. **29** to the state in FIG. **30** to dip measurement electrode **41** of measurement chip **39** in pure water **27**, cam plate **48** is lowered from the state in FIG. **31** to the state in FIG. **32** in conjunction with the lowering operation of front surface cover **19**, thereby causing manipulation body **44** to protrude onto the side of measurement chip **39**. That is, because the upper portion of cam plate **48** protrudes onto the side of front surface cover **19** (the side of measurement chip **39**) compared with the lower portion of cam plate **48**, the upper portion of cam plate **48** pushes manipulation pin **49** of manipulation body **44** onto the side of front surface cover **19** (the side of measurement chip **39**) as cam plate **48** is lowered. As a result, manipulation body **44** invades in through-hole **43** of measurement chip **39** as illustrated in FIG. **33**.

When manipulation body **44** protrudes in the front direction which is the side of front surface cover **19**, spring **47** is compressed as illustrated in FIGS. **30** and **33**.

FIGS. **35**A and **35**B illustrate the state immediately after front surface cover **19** is lifted by the restoring force of spring **33** in FIG. **32** after the measurement. At this point, because protruded flat surface **50** in FIG. **33**B exists in the upper end portion of the cam plate **48**, manipulation body **44** does not retreat but is maintained in a given position immediately after front surface cover **19** is lifted.

However, because connection electrode **40** in the upper end portion of measurement chip **39** is retained by measurement chip-retaining unit **38**, connection electrode **40** is slightly lifted as front surface cover **19** is slightly lifted as illustrated in FIG. **35**A. As a result, hook-shaped engagement portion **45** of manipulation body **44** is engaged with the lower end portion of through-hole **43** of measurement chip **39** as illustrated in FIG. **35**B.

FIGS. **36**A and **36**B illustrate a moment in which front surface cover **19** is further lifted from this state. As illustrated in FIG. **36**A, manipulation pin **49** of manipulation body **44** is separated from flat surface **50** of cam plate **48** by lifting front surface cover **19**, and moves to an inclination portion of cam plate **48**.

As a result, manipulation body **44** retreats rearward by the restoring force of spring **47**, whereby a portion below through-hole **43** of flexible measurement chip **39** is moved rearward. Then, as illustrated in FIG. **36**B, the portion is pressed against the inner wall surface of vessel **22**.

As described above, because hook-shaped engagement portion **45** is provided at the front end of manipulation body **44**, the portion below the through-hole **43** of measurement chip **39** can stably be pulled rearward as illustrated in FIG. **36**B.

On the other hand, a portion above through-hole **43** of measurement chip **39** is retained by measurement chip-retaining unit **38**, the portion above through-hole **43** of measurement chip **39** is inclined forward compared with the portion below through-hole **43** of measurement chip **39**.

FIG. **37** illustrates the state in which front surface cover **19** is further lifted. When front surface cover **19** is lifted to the position in FIG. **37**, connection electrode **40** of measurement chip **39** is separated from measurement chip-retaining unit **38**. In this state, front surface cover **19** is opened upward by handle **34** as illustrated in FIG. **28**, and then measurement chip **39** is picked out from vessel **22**.

In the second exemplary embodiment, one of the features is that, even if front surface cover **19** is opened, measurement chip **39** is not lifted out of vessel **22** in conjunction with the opening operation.

Therefore, even if the opening operation of front surface cover **19** is performed, pure water **27** containing the microorganisms adhering during the measurement is not carelessly spattered or does not drop onto the front portion or lower portion of front surface cover **19**, so that a desirable situation is obtained from a hygiene viewpoint.

In the second exemplary embodiment, as illustrated in FIG. **37**, in order to pick out measurement chip **39** retained by manipulation body **44**, when connection electrode **40** in the upper end portion of measurement chip **39** is picked to slightly press connection electrode **40** in the inward direction of vessel **22** located below, measurement chip **39** is disengaged with through-hole **43** of engagement portion **45** of manipulation body **44**, so that measurement chip **39** can easily be picked out to the outside of vessel **22**.

Additionally, because the upper end portion of connection electrode **40** that is used to pick out measurement chip **39** is not dipped in pure water **27** of vessel **22**, a trouble is not generated from the hygiene viewpoint even if the upper end portion of connection electrode **40** is picked.

FIGS. **38**A and **38**B illustrate the state in which measurement chip **39** mistakenly drops during the work to pick out measurement chip **39**. As illustrated in FIGS. **38**A and **38**B, because dropped measurement chip **39** is retained in vessel **22**, measurement chip **39** does not carelessly drop in a floor, and the trouble is not generated from the hygiene viewpoint.

In the second exemplary embodiment, a length of measurement chip **39** is larger than a depth of vessel **22**. Therefore, even if measurement chip **39** drops in vessel **22** as illustrated in FIGS. **38**A and **38**B, measurement chip **39** can easily be picked out and discarded without touching pure water **27** in vessel **22** by picking the upper end portion of measurement chip **39**.

FIG. **34** illustrates a control block diagram for performing the above operations.

As illustrated in FIG. **34**, motor **35** is connected to motor power supply **52** of power supply **51**, and motor power supply **52** is connected to motor power supply controller **54** of controller **53**. Electrode power supply **55** of power supply **51** is connected to measurement electrode **41**, and electrode power supply **55** is connected to electrode power supply controller **56**.

That is, electrode power supply **55** applies the 3-MHz voltage and the 800-kHz voltage to measurement electrode **41**, and measurement unit **57** and calculator **58**, which are connected to measurement electrode **41**, simultaneously measure the number of microorganisms. A measurement value is displayed on display unit **59** provided at the back of front surface cover **19**.

Manipulation unit **60** illustrated below display unit **59** in FIG. **34** is a power supply manipulation unit. Although switch **36**, display lamp **37**, and measurement start switch **42** in FIG. **18** are not illustrated in FIG. **34**, switch **36**, display lamp **37**, and measurement start switch **42** are connected to controller **53**.

As described above, the microorganism counter of the second exemplary embodiment includes: vessel retaining unit **20** that retains bottomed cylindrical vessel **22** including the upper surface opening with the opening oriented upward; motor (rotation driving unit) **35** that rotates vessel **22** retained by vessel retaining unit **20** around a vertically rotating shaft; measurement chip-retaining unit **38** (constituting the electrode insertion unit) that inserts measurement chip **39** in vessel **22** through the opening from above vessel **22** retained by vessel retaining unit **20**; and measurement unit **57** that measures the microorganism using measurement electrode **41** of measurement chip **39** that is inserted in vessel **22** by the electrode insertion unit, wherein measurement chip **39** is detachably mounted on measurement chip-retaining unit **38** (constituting the electrode insertion unit), and manipulation body **44** (constituting the measurement chip separating body) that retains measurement chip **39** while measurement chip **39** is inserted in vessel **22** is provided. Therefore, reduction of measurement cost can be achieved.

That is, in the microorganism counter of the second exemplary embodiment, the electrode insertion unit that inserts measurement chip **39** in vessel **22** through the opening from above vessel **22** retained by vessel retaining unit **20** is provided. Therefore, the simple vessel having the bottomed cylindrical shape in which the opening is provided on the upper surface may be used as vessel **22**, so that therefore production cost of vessel **22** can be reduced to achieve the reduction of the measurement cost.

In the secondary exemplary embodiment, measurement chip **39** is detachably mounted on measurement chip-retaining unit **38** (constituting the electrode insertion unit), and manipulation body **44** (constituting the measurement chip separating body) that retains measurement chip **39** while measurement chip **39** is inserted in vessel **22** is provided. Therefore, measurement chip **39** is not spattered or does not drop in discharging measurement chip **39** after the measurement. As a result, the hygiene effect can be enhanced.

In the second exemplary embodiment, when vessel **22** is rotated, four ribs **61** are provided at 90-degree intervals outside the bottom surface of vessel **22** as illustrated in FIG. **39**, and driving protrusions **21** in FIG. **26** may be coupled to ribs **61**.

As illustrated in FIG. **26**, because two driving protrusions **21** are provided at 180-degree intervals, when vessel retaining unit **20** is rotated by motor **35**, driving protrusions **21** can abut on ribs **61** existing in the rotating direction to rotate vessel **22**. When motor **35** is reversely rotated, driving protrusions **21** can abut on ribs **61** on the reverse rotation side to reversely rotate vessel **22**.

In the second exemplary embodiment, as illustrated in FIG. **33**C, hook-shaped engagement portion **45** is provided on the lower surface at the front end of manipulation body **44**, and the lower end side of through-hole **43** of measurement chip **39** is engaged with engagement portion **45** when measurement chip **39** is separated. Alternatively, a structure in which hook-shaped engagement portion **45** is not provided at the front end of manipulation body **44** may be adopted as illustrated in FIG. **40**.

When hook-shaped engagement portion **45** is not provided, front end portion **62** of manipulation body **44** invades in through-hole **43** of measurement chip **39** as illustrated in FIG. **40** while front surface cover **19** is closed as illustrated in FIG. **30**.

In opening front surface cover **19** after the measurement, the lower end of through-hole **43** of measurement chip **39** is engaged with front end portion **62** of manipulation body **44**, and therefore measurement chip **39** is separated from measurement chip-retaining unit **38**. In opening front surface cover **19**, when manipulation body **44** is pulled rearward (right side) in FIG. **40** while measurement chip **39** is separated from measurement chip-retaining unit **38**, front end portion **62** of manipulation body **44** is extracted from through-hole **43** of measurement chip **39**.

Therefore, measurement chip **39** drops in vessel **22**.

Accordingly, when front surface cover **19** is opened after the measurement, measurement chip **39** is taken out from vessel retaining unit **20** while stored in vessel **22**, and discarded as a medical waste.

## Third Exemplary Embodiment

In the second exemplary embodiment, the elution of the microorganisms into pure water **27** is performed such that, while front surface cover **19** is opened, the upper portion of microorganism collecting tool **30** is picked by the fingers of the right hand, for example, to rotate vessel **22** through vessel retaining unit **20** using motor **35**.

On the other hand, in a configuration of a third exemplary embodiment, when front surface cover **19** is closed, the upper portion of microorganism collecting tool **30** is retained by the microorganism collecting tool retaining unit (not illustrated) provided on the inner surface side of front surface cover **19**. According to the configuration of the third exemplary embodiment, the operation to pick the upper portion of microorganism collecting tool **30** between the fingers is eliminated during the elution of the microorganisms into pure water **27**.

Specifically, when manipulation button **32** in FIG. **16** provided on the lower portion of the front surface of body case **18** is pressed, front surface cover **19** is unlocked and slightly lifted front surface cover **19** as illustrated in FIG. **17**.

As illustrated in FIG. **32**, springs **33** are mounted on both sides in front surface cover **19** in order to lift front surface cover **19**. As described above, when front surface cover **19** is unlocked, the elongated springs **33** in FIG. **32** are returned to the original state in FIG. **31**, and front surface cover **19** is lifted by the restoring force at that time. FIGS. **31** and **32** illustrate the later-described operation, and front surface cover **19** is not illustrated for the purpose of easy understanding of an operation to lift front surface cover **19**.

After front surface cover **19** is lifted, handle **34** provided at the lower end of the front surface of front surface cover **19** is grasped, front surface cover **19** is lifted and opened, and vessel retaining unit **20** is exposed from body case **18** as illustrated in FIG. **18**.

As illustrated in FIG. **22**, because cover **28** is attached to the upper surface opening of vessel **22**, cover **28** is detached from the upper surface opening of vessel **22**. At this point, as illustrated in FIGS. **24** and **25**, vessel **22** is inserted from below in the upper surface opening of vessel retaining unit **20**, whereby the lower portion and outer circumferential portion of vessel **22** are retained by vessel retaining unit **20**.

As illustrated in FIGS. **21**A and **21**B, pure water **27** is stored in vessel **22** retained by vessel retaining unit **20**, and collecting element **31** of microorganism collecting tool **30** in FIGS. **20**A and **20**B is inserted in pure water **27**. Before collecting element **31** of microorganism collecting tool **30** in FIGS. **20**A and **20**B is inserted in pure water **27**, collecting element **31** is inserted in the oral cavity to collect the microorganisms in the oral cavity.

As illustrated in FIGS. **24** and **25**, collecting element **31** of microorganism collecting tool **30** is inserted from above in retaining body **23**. At this point, as illustrated in FIGS. **24** and **25**, because front surface cover **19** is turned behind the space above the upper surface opening of vessel **22**, the work to insert collecting element **31** of microorganism collecting tool **30** in retaining body **23** can extremely easily be performed.

As illustrated in FIGS. **21** and **23**, protrusion **29** is provided on the lower portion of the bottom surface of vessel **22**. As illustrated in FIG. **26**, driving protrusion **21** is provided on the bottom surface of vessel retaining unit **20** that retains vessel **22**.

In the third exemplary embodiment, at this point, measurement chip **39** in FIG. **27** is mounted on measurement chip-retaining unit **38** provided on the inner surface of front surface cover **19**.

Specifically, measurement chip **39** is formed into a rectangular plate shape as illustrated in FIG. **27**, connection electrode **40** to measurement chip-retaining unit **38** is provided at an upper end of measurement chip **39**, and measurement electrode **41** is provided at an lower end of measurement chip **39**.

Accordingly, when an intermediate portion of measurement chip **39** is picked to mount connection electrode **40** on measurement chip-retaining unit **38** as illustrated in FIG. **28**, the electrical and mechanical connections are established.

Specifically, the electrode insertion unit includes front surface cover **19** and measurement chip-retaining unit **38**. As illustrated in FIG. **28**, when front surface cover **19** is lifted and opened, in the electrode insertion unit above vessel **22**, a measurement chip insertion port of measurement chip-retaining unit **38** is oriented upward from a horizontal position.

Therefore, connection electrode **40** of measurement chip **39** can easily be mounted on measurement chip-retaining unit **38** while the measurement chip insertion port of measurement chip-retaining unit **38** is visually checked.

After the state in FIG. **28**, when handle **34** is grasped to turn front surface cover **19** frontward and downward to cover the front surface of body case **18** as illustrated in FIG. **29**, measurement chip **39** is inserted in the upper surface opening of vessel **22**. When handle **34** is further lowered as illustrated in FIG. **30**, front surface cover **19** is lowered to the state in FIG. **16**, and the front surface cover **19** is locked. At this point, measurement electrode **41** of measurement chip **39** is dipped in pure water **27** of vessel **22**.

When front surface cover **19** is lowered to the state in FIG. **16**, the upper portion of microorganism collecting tool **30** is retained by the microorganism collecting tool retaining unit (not illustrated) provided on the inner surface side of front surface cover **19**. According to the configuration of the third exemplary embodiment, unlike the second exemplary embodiment, the operation to pick the upper portion of microorganism collecting tool **30** between the fingers is eliminated during the elution of the microorganisms into pure water **27**.

Front surface cover **19** is lowered to the state in FIG. **16**, measurement electrode **41** of measurement chip **39** is dipped in pure water **27** of vessel **22**, and the upper portion of microorganism collecting tool **30** is retained by the microorganism collecting tool retaining unit (not illustrated). At this point, measurement start switch **42** in FIG. **16** is pressed.

Therefore, vessel retaining unit **20** is rotated by motor **35** in FIG. **25**, and driving protrusion **21** and protrusion **29** are engaged with each other, thereby rotating vessel **22**.

Because the upper portion of microorganism collecting tool **30** is retained by the microorganism collecting tool retaining unit (not illustrated), microorganism collecting tool **30** is not rotated but maintained in a constant state. At this point, as described above, vessel **22** is rotated by motor **35** through vessel retaining unit **20** for a set timer time (for example, 10 seconds).

At this point, the whole circumference of retaining body **23** of vessel **22** is divided into three portions, elution groove **25** exists in the divided portion, and elution protrusion **24** is provided on the inner circumferential surface. Therefore, the pressure is applied from the outside to collecting element **31** of microorganism collecting tool **30** by rotated elution protrusions **24**. Therefore, the microorganisms (bacteria) collected by collecting element **31** are extremely effectively eluted into pure water **27** in retaining body **23**, and the next moment, the microorganisms are widely eluted into pure water **27** in vessel **22** through elution groove **25**.

Then, for example, a 3-MHz voltage is applied to measurement electrode **41** to collect the microorganism eluted in vessel **22** to the portion of measurement electrode **41**. At the same time, for example, an 800-kHz voltage is applied to measurement electrode **41** to measure the number of microorganisms.

Because the measurement of the number of microorganisms is well known by the prior literature, the description is simplified for purposes of clarity of description. In the third exemplary embodiment, during the measurement of the number of microorganisms, vessel retaining unit **20** and vessel **22** are rotated by motor **35** to increase the opportunity of bringing the microorganisms diffused widely in vessel **22** close to measurement electrode **41**.

In the state in which the number of microorganisms is measured using measurement chip **39**, rod-shaped manipulation body **44** constituting the measurement chip separating body is inserted in through-hole **43** in FIG. **27** provided on the intermediate portion of measurement chip **39** as illustrated in FIG. **30**.

This point will be described in detail. As is clear from FIG. **29**, manipulation body **44** is retreated rearward until measurement chip **39** is lowered to vessel **22**. As illustrated in FIG. **30**, manipulation body **44** protrudes toward the direction of front surface cover **19** before measurement chip **39** is completely lowered to vessel **22**.

As can be seen from FIGS. **27**, **33**B, and **33**C, because through-hole **43** made in measurement chip **39** is vertically long, manipulation body **44** can protrude even before measurement chip **39** is completely lowered.

As illustrated in FIG. **33**C, hook-shaped engagement portion **45** is provided on a lower surface at the front end of manipulation body **44**, and the lower end side of through-hole **43** of measurement chip **39** is engaged with engagement portion **45** when measurement chip **39** is separated.

In the third exemplary embodiment, the number of microorganisms in vessel **22** can be measured in the state in FIG. **30**. However, as illustrated in FIG. **28**, when front surface cover **19** is opened and closed after the measurement, measurement chip **39** is largely lifted out of vessel **22** along with front surface cover **19**, and measurement chip **39** is in the state in which the measurement is already performed in vessel **22**. That is, as illustrated in FIG. **28**, when measurement chip **39** is lifted along with front surface cover **19** after the measurement, undesirably pure water **27** containing the microorganisms adhering during the measurement is carelessly spattered or drops onto the front portion or lower portion of front surface cover **19**. Therefore, in the third exemplary embodiment, manipulation body **44** constituting the measurement chip separating body is provided as described above.

Specifically, when the number of microorganisms is measured using measurement chip **39**, namely, when measurement electrode **41** of measurement chip **39** is dipped in pure water **27** as illustrated in FIG. **30**, manipulation body **44** is already protruded in through-hole **43** of measurement chip **39**.

The mechanism in FIGS. **31** and **32** causes manipulation body **44** to protrude from the state in FIG. **29** to the state in FIG. **30**, and causes manipulation body **44** to retreat from the state in FIG. **30** to the state in FIG. **29**. Manipulation body **44** is slidably provided on cylindrical guide tube **46**, and guide tube **46** is fixed to body case **18**. In guide tube **46**, manipulation body **44** is always biased in the rear direction opposite to front surface cover **19** by spring **47** in FIG. **29**. FIGS. **29** and **31** illustrate this state.

When front surface cover **19** is further pushed down from the state in FIG. **29** to the state in FIG. **30**, namely, when measurement electrode **41** of measurement chip **39** is dipped in pure water **27**, cam plate **48** is lowered from the state in FIG. **31** to the state in FIG. **32** in conjunction with the lowering operation of front surface cover **19**, thereby causing manipulation body **44** to protrude onto the side of measurement chip **39**. That is, because the upper portion of cam plate **48** protrudes in the front direction which is the side of front surface cover **19** (the side of measurement chip **39**) compared with the lower portion of cam plate **48**, the upper portion of cam plate **48** pushes manipulation pin **49** of manipulation body **44** onto the side of front surface cover **19** (the side of measurement chip **39**) as cam plate **48** is lowered. As a result, manipulation body **44** invades in through-hole **43** of measurement chip **39** as illustrated in FIGS. **33**B and **33**C.

When manipulation body **44** protrudes onto the side of front surface cover **19** (the side of measurement chip **39**), spring **47** is compressed as illustrated in FIGS. **30** and **33**A.

FIGS. **35**A and **35**B illustrate the state immediately after front surface cover **19** is lifted by the restoring force of spring **33** in FIG. **32** after the measurement. At this point, because protruded flat surface **50** in FIG. **33** exists in the upper end portion of the cam plate **48**, manipulation body **44** does not retreat but is maintained in a given position immediately after front surface cover **19** is lifted.

However, because connection electrode **40** in the upper end portion of measurement chip **39** is retained by measurement chip-retaining unit **38**, connection electrode **40** is slightly lifted as front surface cover **19** is slightly lifted as illustrated in FIGS. **35**A and **35**B. As a result, hook-shaped engagement portion **45** of manipulation body **44** is engaged with the lower end portion of through-hole **43** of measurement chip **39** as illustrated in FIG. **35**B.

FIGS. **36**A and **36**B illustrate the moment in which front surface cover **19** is further lifted from this state. As illustrated in FIG. **36**A, manipulation pin **49** of manipulation body **44** is separated from flat surface **50** of cam plate **48** by lifting front surface cover **19**, and moves to the inclination portion of cam plate **48**.

As a result, manipulation body **44** retreats rearward by the restoring force of spring **47**, whereby a portion below through-hole **43** of flexible measurement chip **39** is moved rearward. Then, as illustrated in FIG. **36**B, the portion is pressed against the inner wall surface of vessel **22**.

As described above, because hook-shaped engagement portion **45** is provided at the front end of manipulation body **44**, the portion below the through-hole **43** of measurement chip **39** can stably be pulled rearward as illustrated in FIG. **36**B.

On the other hand, a portion above through-hole **43** of measurement chip **39** is retained by measurement chip-retaining unit **38**, the portion above through-hole **43** of measurement chip **39** is inclined forward compared with the portion below through-hole **43** of measurement chip **39**.

FIG. **37** illustrates the state in which front surface cover **19** is further lifted. When front surface cover **19** is lifted to the position in FIG. **37**, connection electrode **40** of measurement chip **39** is separated from measurement chip-retaining unit **38**. At this point, front surface cover **19** is opened upward by handle **34** as illustrated in FIG. **28**, and then measurement chip **39** is picked out from vessel **22**.

In the third exemplary embodiment, one of the features is that, even if front surface cover **19** is opened, measurement chip **39** is not lifted out of vessel **22** in conjunction with the opening operation.

Therefore, even if the opening operation of front surface cover **19** is performed, pure water **27** containing the microorganisms adhering during the measurement is not carelessly spattered or does not drop onto the front portion or lower portion of front surface cover **19**, so that a desirable situation is obtained from a hygiene viewpoint.

In the third exemplary embodiment, as illustrated in FIG. **37**, in order to pick out measurement chip **39** retained by manipulation body **44**, when connection electrode **40** in the upper end portion of measurement chip **39** is picked to slightly press connection electrode **40** in the inward direction of vessel **22** located below, measurement chip **39** is disengaged with through-hole **43** of engagement portion **45** of manipulation body **44**, so that measurement chip **39** can easily drop in vessel **22**. In order that measurement chip **39** drops in vessel **22**, a manipulation body including front end portion **62** at the front end may be used as manipulation body **44** as illustrated in FIG. **40**.

As illustrated in FIG. **38**, because dropped measurement chip **39** is retained in vessel **22**, the trouble is not generated from the hygiene viewpoint.

In the third exemplary embodiment, when front surface cover **19** is opened after the measurement, because measurement chip **39** and microorganism collecting tool **30** are stored in vessel **22**, vessel **22** is taken out from vessel retaining unit **20**, and measurement chip **39** and microorganism collecting tool **30** are discarded as the medical waste along with vessel **22**.

Therefore, vessel **22**, measurement chip **39**, and microorganism collecting tool **30** can be discarded as the medical waste without touching pure water **27** in vessel **22**.

FIG. **34** illustrates the control block diagram for performing the above operations. As illustrated in FIG. **34**, motor **35** is connected to motor power supply **52** of power supply **51**, and motor power supply **52** is connected to motor power supply controller **54** of controller **53**. Electrode power supply **55** of power supply **51** is connected to measurement electrode **41**, and electrode power supply **55** is also connected to electrode power supply controller **56**. That is, electrode power supply **55** applies the 3-MHz voltage and the 800-kHz voltage to measurement electrode **41**, and measurement unit **57** and calculator **58**, which are connected to measurement electrode **41**, simultaneously measure the number of microorganisms.

A measurement value is displayed on display unit **59** provided at the back of front surface cover **19**.

Manipulation unit **60** illustrated below display unit **59** in FIG. **34** is the power supply manipulation unit. Although switch **36**, display lamp **37**, and measurement start switch **42** in FIG. **18** are not illustrated in FIG. **34**, switch **36**, display lamp **37**, and measurement start switch **42** are connected to controller **53**.

Fourth Exemplary Embodiment

A fourth exemplary embodiment is different from the third exemplary embodiment in that, as illustrated in FIG. **41**, vessel **63** having a inclined bottom surface is used instead of vessel **22** having the flat bottom surface of the third exemplary embodiment in FIG. **22**.

That is, the bottom surface of vessel **63** used in the fourth exemplary embodiment is configured to be inclined upward from the outer circumferential surface of retaining body **23** vertically disposed on the bottom surface of vessel **63** to the inner wall surface of vessel **63**. More specifically, the bottom surface of vessel **63** is inclined at an angle of 30 degrees.

Therefore, a water flow is formed in a vertical direction as illustrated in FIG. **41**, and the microorganisms (bacteria) eluted in pure water **27** of vessel **63** increase the opportunity of coming close to measurement electrode **41** of measurement chip **39**, so that the measurement time can be shortened.

More particularly, during the measurement, vessel retaining unit **20** and vessel **63** are rotated by motor **35**. At this point, as illustrated in FIG. **41**, the rotating shaft portion of pure water **27** is largely recessed while the outer circumferential portion (the inner surface portion of vessel **63**) of pure water **27** rises. That is, a spiral swirling flow is formed in vessel **63**.

At this point, the bottom surface of vessel **63** is inclined upward from the outer circumferential surface of retaining body **23** vertically disposed on the bottom surface of vessel **63** to the inner wall surface of vessel **63**. Therefore, pure water **27** of vessel **63** rises along the inclination surface of the bottom surface of vessel **63** and forms a rising water flow rising along the inner wall surface of vessel **63**, and pure water **27** forms a falling water flow flowing along the outer circumferential surface in the outer circumferential surface of retaining body **23**. That is, the water flow is formed in the vertical direction.

The microorganisms (bacteria) eluted in pure water **27** move into the strong rising water flow to rise along the inclination surface of the vessel bottom surface, and reach measurement electrode **41** (FIG. **33**A) of measurement chip **39**.

Accordingly, the microorganisms (bacteria) eluted in pure water **27** of vessel **63** increase the opportunity of coming close to measurement electrode **41** of measurement chip **39**. As a result, the microorganism elution time can be shortened while the measurement time is shortened.

As described above, the microorganism counting cell of the present invention includes: the bottomed cylindrical vessel that includes the upper surface opening; and the cylindrical retaining body disposed vertically on the bottom surface in the vessel, and has the collecting element provided on the lower end portion of the rod-shaped microorganism collecting tool being inserted in the retaining body from the upper surface opening, the plurality of first elution protrusions of a longwall shape formed in an axial direction of the retaining body at predetermined intervals around the interior side surface of the retaining body, and the elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions.

That is, in the present invention, because the cylindrical retaining body is vertically disposed on the bottom surface in the vessel, the collecting element provided on the lower end portion of the rod-shaped microorganism collecting tool is inserted from the upper surface opening of the vessel.

At this point, because the plurality of first elution protrusions formed into longwall shape in the axial direction of the retaining body are provided at predetermined intervals in the interior side surface of the retaining body, the portion from the lower portion to upper portion of the collecting element abuts on the first elution protrusions formed into the longwall shape in the axial direction at predetermined intervals. When the microorganism collecting tool is rotated, the microorganisms can be eluted from the whole portion from the lower portion to the upper portion of the collecting element of the microorganism collecting tool.

The elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions. Therefore, the microorganisms eluted from the collecting element of the microorganism collecting tool can be eluted to the vessel through the elution grooves.

As a result, the microorganism elution time can be shortened.

The eluted microorganisms can be eluted out of the retaining unit through the elution grooves, namely, into the liquid in the vessel. Therefore, the subsequent measurement can easily be performed.

INDUSTRIAL APPLICABILITY

As described above, the microorganism counting cell of the present invention includes: the bottomed cylindrical vessel that includes the upper surface opening; and the cylindrical retaining body disposed vertically on the bottom surface in the vessel, has the collecting element provided on the lower end portion of the rod-shaped microorganism collecting tool being inserted in the retaining body from the upper surface opening, the plurality of first elution protrusions of a longwall shape formed in an axial direction of the retaining body at predetermined intervals around the interior side surface of the retaining body, and the elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions. Therefore, the microorganism elution time can be shortened.

That is, in the present invention, because the cylindrical retaining body is vertically disposed on the bottom surface in the vessel, the collecting element provided on the lower end portion of the rod-shaped microorganism collecting tool is inserted from the upper surface opening of the vessel.

At this point, because the plurality of first elution protrusions formed into longwall shape in the axial direction of the retaining body are provided at predetermined intervals in the interior side surface of the retaining body, the portion from the lower portion to upper portion of the collecting element abuts on the first elution protrusions formed into the longwall shape in the axial direction at predetermined intervals. When the microorganism collecting tool is rotated, the microorganisms can be eluted from the whole portion from the lower portion to the upper portion of the collecting element of the microorganism collecting tool.

The elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions. Therefore, the microorganisms eluted from the collecting element of the microorganism collecting tool can be eluted to the vessel through the elution grooves.

As a result, the microorganism elution time can be shortened.

The eluted microorganisms can be eluted out of the retaining unit through the elution grooves, namely, into the liquid in the vessel. Therefore, the subsequent measurement can easily be performed.

Accordingly, the present invention is expected to be widely used as the microorganism counting cell and the microorganism counter provided with the microorganism counting cell.

REFERENCE MARKS IN THE DRAWINGS

**1** Vessel
**1***a* Fixing hole
**1***b* Rib
**1***c* Vessel retaining unit
**1***d* Driving protrusion
**1***e* Motor
**2** Upper surface opening
**3** Cotton swab
**3***a* Rod
**4** Collecting element
**4***a* Swab portion
**5** Retaining body
**5***a* Side surface body
**6** Elution groove
**7** Elution protrusion
**8** Elution protrusion
**9** Pure water
**10** Step portion
**11** Cover body
**12** Vessel support
**13** Mounting unit
**13***a* Projection
**14** Rotation tool
**15** Cotton swab mounting unit
**16** Switch
**17** Motor
**18** Body case
**19** Front surface cover
**20** Vessel retaining unit
**21** Driving protrusion
**22** Vessel
**23** Retaining body
**24** Elution protrusion
**25** Elution groove
**26** Elution protrusion
**27** Pure water
**28** Cover
**29** Protrusion
**30** Microorganism collecting tool
**31** Collecting element
**32** Manipulation button
**33** Spring
**34** Handle
**35** Motor
**36** Switch
**37** Display lamp
**38** Measurement chip-retaining unit
**39** Measurement chip
**40** Connection electrode
**41** measurement electrode
**42** Measurement start switch
**43** Through-hole
**44** Manipulation body
**45** Engagement portion
**46** Guide tube
**47** Spring
**48** Cam plate
**49** Manipulation pin
**50** Flat surface
**51** Power supply
**52** Motor power supply
**53** Controller
**54** Motor power supply controller
**55** Electrode power supply
**56** Electrode power supply controller
**57** Measurement unit
**58** Calculator
**59** Display unit
**60** Manipulation unit
**61** Rib
**62** Front end portion
**63** Vessel

The invention claimed is:

**1**. A microorganism counting cell, comprising:

a bottomed cylindrical vessel that includes an upper surface opening; and

a cylindrical retaining body disposed vertically on a bottom surface in the vessel for receiving a collecting element provided on a lower end portion of a rod-shaped microorganism collecting tool inserted therein, the retaining body disposed such that a radially exterior side surface of the retaining body is spaced from a radially interior side surface of the cylindrical vessel,

a space that is formed in a shape of substantially circular ring between an inner peripheral surface of the vessel and an outer peripheral surface of the retaining body, and in which a liquid for eluting a microorganism is filled, and

a liquid filled in the space formed between the radially exterior side surface of the retaining body and the radially interior side surface of the cylindrical vessel, and wherein

the retaining body is provided with a plurality of first elution protrusions of a longwall shape formed in an axial direction of the retaining body at predetermined intervals around a radially interior side surface of the retaining body, and elution grooves, each formed to cut through a side surface of the retaining body from the inside to the outside between adjoining two of the plurality of first elution protrusions.

**2**. The microorganism counting cell according to claim **1**, wherein

the cylindrical retaining body is configured to retain a side surface of the collecting element of the microorganism collecting tool inserted in the retaining body such that the side surface of the collecting element is made to abut on the plurality of first elution protrusions provided on the interior side surface of the retaining body.

**3**. The microorganism counting cell according to claim **1**, wherein

side surface bodies of an odd number are provided around the side surface of the retaining body.

**4**. The microorganism counting cell according to claim **1**, wherein

a width of the elution groove in a circumferential direction of the retaining body is smaller than a thickness of a rod of the microorganism collecting tool inserted in the retaining body.

5. The microorganism counting cell according to claim 1, wherein

a plurality of second elution protrusions are provided circularly at equal intervals around an axis of the retaining body in an interior bottom surface of the retaining body.

6. The microorganism counting cell according to claim 1, wherein

a liquid is provided on the vessel, and a cover body is detachably provided on the upper surface opening of the vessel.

7. The microorganism counting cell according to claim 1, wherein

a coupling unit is provided on the outside of the vessel bottom surface for coupling to a rotation driving unit that rotates the vessel.

8. A microorganism counter, comprising:

a vessel retaining unit that retains the bottomed cylindrical vessel including the upper surface opening of the microorganism counting cell according to claim 1 with the opening oriented upward;

a rotation driving unit that rotates the vessel retained by the vessel retaining unit around a vertically rotating shaft;

an electrode insertion unit that inserts a measurement chip in the vessel through the opening from above the vessel retained by the vessel retaining unit; and

a measurement unit that measures a microorganism using a measurement electrode of the measurement chip that is inserted in the vessel by the electrode insertion unit.

9. The microorganism counter according to claim 8, wherein

the bottom surface of the bottomed cylindrical vessel is upwardly inclined toward an inner wall surface of the vessel.

10. The microorganism counter according to claim 8, wherein

the vessel retaining unit is configured to rotate the vessel while retaining an outer circumference of the vessel.

11. The microorganism counter according to claim 10, wherein

the vessel retaining unit is formed into a bottomed cylindrical shape including an opening in an upper surface.

12. The microorganism counter according to claim 11, wherein

the vessel retaining unit is provided with a driving protrusion that protrudes toward a coupling unit provided on the outside of the vessel bottom surface.

13. The microorganism counter according to claim 8, wherein

the electrode insertion unit includes a measurement chip-retaining unit that detachably retains the measurement chip.

14. The microorganism counter according to claim 13, wherein

the measurement chip is mounted above a horizontal position on the electrode insertion unit, and the measurement chip is inserted in the vessel by turning the measurement chip downward.

15. A microorganism counter, comprising:

a vessel retaining unit that retains the bottomed cylindrical vessel including the upper surface opening of the microorganism counting cell according to claim 1 with the opening oriented upward;

a rotation driving unit that rotates the vessel retained by the vessel retaining unit around a vertically rotating shaft;

an electrode insertion unit that inserts a measurement chip in the vessel through the opening from above the vessel retained by the vessel retaining unit; and

a measurement unit that measures a microorganism using a measurement electrode of the measurement chip that is inserted in the vessel by the electrode insertion unit, wherein

the measurement chip is detachably mounted on the electrode insertion unit, and

the microorganism counter further comprises a measurement chip separating body that retains the measurement chip while being inserted in the vessel.

16. The microorganism counter according to claim 15, wherein

the measurement chip separating body comprises a manipulation body that is inserted in a through-hole formed in the measurement chip.

17. A microorganism counter, comprising:

a body case;

a front surface cover that covers a front surface side of the body case in an openable manner;

a vessel retaining unit provided inside the body case behind the front surface cover, and retains the bottomed cylindrical vessel including the upper surface opening of the microorganism counting cell according to claim 1 with the opening oriented upward;

a rotation driving unit that rotates the vessel retained by the vessel retaining unit around a vertically rotating shaft;

an electrode insertion unit that inserts a measurement chip in the vessel through the opening from above the vessel retained by the vessel retaining unit; and

a measurement unit that measures a microorganism using a measurement electrode of the measurement chip that is inserted in the vessel by the electrode insertion unit, wherein

the measurement chip is detachably mounted on the electrode insertion unit, and

the microorganism counter further comprises a measurement chip separating body that retains the measurement chip while being inserted in the vessel.

18. The microorganism counter according to claim 17, wherein

the measurement chip separating body comprises a manipulation body that is inserted in a through-hole formed in the measurement chip, and a manipulation pin provided in the manipulation body, wherein the manipulation pin is engaged with a cam plate that is operated by opening and closing operations of the front surface cover.

19. The microorganism counter according to claim 18, wherein

the cam plate is provided with a flat surface unit that puts the manipulation pin into a non-driving state at a beginning of the opening and closing of the front surface cover.

20. A microorganism counting method using the microorganism counter according to claim 17, the method comprising:

mounting the vessel on the vessel retaining unit while the front surface cover provided on the front surface side of the body case is opened;

inserting a collecting element provided on a lower end portion of a rod-shaped microorganism collecting tool in a retaining body of the vessel;

mounting the measurement chip on the electrode insertion unit;

closing the front surface cover provided on the front surface side of the body case to have the electrode insertion unit insert the measurement chip in the vessel;

rotating the vessel by the rotation driving unit to elute a microorganism into a liquid in the vessel; and

measuring a number of the microorganisms with the measurement chip of the electrode insertion unit.

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